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SEE NATIONAL GEOGRAPHIC SPECIAL, "GOLD!" SUNDAY, JAN. 7, ON PBS TV

ON JANUARY 7, National Geographic Specials will begin a fourth season over television stations of the Public Broadcasting Service—an event that has become a happening. Last year, “The Great Whales” and “The Living Sands of Namib” drew the largest audiences of all PBS programs rated during the season, and “The Great Whales” went on to win a coveted Emmy award.

We rejoice in such success, not only for the men and women who work so hard to make good programs possible, but also because it means significant numbers of television viewers appreciate informative and interesting programming. We believe that the same standards we seek to maintain in our magazine and other publications can be maintained on television, and not only survive but be welcomed.

Our new season opens with “Gold!”—a report on the lure and beauty of the precious metal. A mine in South Africa, a treasure hunters’ excavation of an ancient Colombian grave, a gold-bedecked wedding in India, and the vault at Fort Knox are among the settings for the story.

On January 28, “Hong Kong: A Family Portrait” will show you the Crown Colony from a view seldom shared by the tourist. We come to know the members of a Chinese family and see through their eyes that remarkable Far Eastern economic machine.

The scene shifts to East Africa on March 4 and a drama of utmost importance to all those who revere the wildlife threatened by poachers and changing land use. “Last Stand in Eden” tells the story of elephants forced into a farm area, and the complexity of rights and wrongs that results.

The season concludes on April 1 with “The Tigris Expedition.” With Norwegian mariner-adventurer Thor Heyerdahl, we sail aboard the reed boat *Tigris* through waters traveled by the ancient Sumerians, along sea routes by which man’s earliest civilizations may have spread.

As in previous seasons, the Society and station WQED in Pittsburgh, our PBS associate, are indebted to Gulf Oil Corporation, whose generous grants make these programs possible. We are indebted most, however, to the millions of viewers who continue to approve of good programming.

Silvestre A. Brosnan

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HUMPBAC WHALES

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Marine biologist Sylvia A. Earle and photographer Al Giddings swim confidently among those benign behemoths off Hawaii and Alaska.

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A 12-year study by zoologist Roger Payne and his wife of the complex, ever changing sounds made by humpbacks suggests that the “songs” may relate to social behavior and possibly even intelligence. An accompanying sound sheet reproduces some of these haunting sequences, as yet unfathomed.

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The era of freewheeling sprawl, smog, and shonky runs into a space problem, and a flood of Spanish-speaking newcomers brings a new flavor. William S. Ellis and Jodi Cobb explore what’s happening in our third largest metropolis.

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Why is the hardest of substances ever more precious to man? Fred Ward visits mines, cutting rooms, dealers, and buyers on four continents to assess that fabulous crystal.

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COVER: Symbols of life’s frailty, flowers are laid at the feet of a colossal Buddha in Sri Lanka. Photograph by Raghavie Singh.

HUMPBACKS:

The Gentle Whales

By SYLVIA A. EARLE, Ph.D.

Photographs by AL GIDDINGS

with Sylvia Earle, 1974

In a breathtaking encounter, photographer Chuck Nicklin watches motionless as a pair of humpback whales sweeps past at arm's length, peaceful giants that bear him no malice. Nicklin uses a rebreather, a scuba device that emits few bubbles and thus minimizes his presence.

In this issue two scientists train their eyes and ears on the humpbacks' hidden world. Sylvia Earle meets individuals flipper-to-flipper, studies small creatures that travel with them, and observes the whales' fascinating feeding tactics. The report of Roger Payne, an authority on their enchanting "songs," features a detachable sound sheet on pages 24A and 24B.

WITH MORE UNCERTAINTY than I have felt in thousands of dives, I eased into the water with four humpback whales.

Humpbacks have a reputation for being gentle, but forty tons is forty tons. Here, in the violet waters off Maui, one of Hawaii's islands, I prepared for the first time to meet these great whales in their own element.

From below me a dark shape—roughly eight hundred times my size—swiftly came up to within touching distance. With magnificent grace the giant swept by, as supple as an otter and with a dolphinlike expression of good humor. The great eye tilted slightly, enough to suggest that the whale had gone out of its way to look me over.

I glanced at my diving partners, photographers Al Giddings and Chuck Nicklin, dwarfed by our four enormous underwater companions. The whale that had inspected me now turned and swam toward Al on what appeared to be a collision course. At the last moment the whale artfully lifted its flipper, avoiding contact with Al by inches.

I stopped worrying then, and have never worried since in all my encounters with humpbacks. Their reputation is well deserved. They are without doubt the gentlest of giants.

That memorable dive off Maui began a fascinating study. With Al and Chuck I had joined Roger Payne and his wife, Katy—authorities on whales—in a research project on the humpbacks of Hawaii. The effort was supported by the National Geographic Society, the California Academy of Sciences, the New York Zoological Society, the World Wildlife Fund, and, in Hawaii, the Lahaina Restoration Foundation.

Roger and Katy's interest focused on underwater "songs" of the humpback whale, a phenomenon they have studied for more than a decade. (See the following article.) Graduate students Peter Tyack and Jim Darling assisted in the study, while Al and Chuck, together with Al's assistants, Steve Bowerman and Terry Frohm, documented the activities of humpbacks on film.

As a marine biologist, I was interested in humpbacks as floating islands in the sea. Just like a ship's hull, the whale's hide is home for a variety of barnacles, algae, and





parasites. In addition, humpbacks occasionally have free-swimming associates, such as fishes and lesser whales.

Mostly I wanted to become familiar with whales as living animals in their own realm. Until recently data about humpbacks has come from whaling records and beached carcasses. Often I have wondered how much an alien species would guess about us if they had engaged us in war and studied only our remains—never asking what we think or do, never listening to our music.

Maui is an ideal spot for encountering

whales. Every winter several hundred humpbacks come to Hawaii's warm, clear waters to bear their young and possibly to mate. The whales begin to arrive in November and peak in mid-February. By June most of them are gone, presumably migrating to colder waters to feed.

A century ago the island of Maui and its picturesque port, Lahaina, were way stations in the wholesale slaughter of whales.* Like the humpbacks, American whaling

*See the articles and special map and painting on "Whales of the World," *Geographic*, December 1976.

ships wintered in the tropical waters, creating a forest of masts in Lahaina Roadstead.

Today the humpback is protected around the world, and Lahaina supports a new whaling fleet—dozens of charter boats for tourists and whale-watchers who flock to Maui during the humpbacks' winter visit. To this armada we added our own small fleet: a three-masted sailing ship named *Sa-journ*, another research vessel, *Easy Rider*, and two inflatable boats.

After our initial contact with the whales, we settled down to work. On a subsequent dive among the whales at close range, I wrote on my underwater notebook: "stringy goose barnacles on throat pleats . . . five acorn barnacles on leading edge of right flipper." Then I sketched the genital slit ending near the rounded anus, which identified my subject as a female.

Humpbacks probably can tell readily who is a "he" and who is a "she," but it is not so easy for a human observer. Sometimes a whale turns so that the slit enclosing a male's genitals, widely separated from the anus, is evident. But usually in our studies, unless an adult was accompanied by a young calf, we had to mark it "sex unknown."

Sleek Candidates for Whale Olympics

At first we were concerned that our presence in the water might disturb the whales, but we soon learned that they were sometimes as curious about us as we were about them. Once five of them swam with us for nearly two hours!

Watching these lithe, acrobatic creatures with their long, slim faces and supple bodies, I thought how ironic it is that they are called "humpbacks" and that they are traditionally represented as ponderous, stocky, misproportioned creatures with bulging throats and lumpy bodies—impressions derived, I suspect, from dead whales. Most illustrations bear faint resemblance to the leaping, diving, flippering reality.

As viewed in Hawaii, *Megaptera novae-angliae*—the Latin term means roughly "big-winged New Englander"—resembles more a sleek seabird than the pudgy monster so often depicted. The look of these fine animals, and the apparent exchange of awareness between them and us, will haunt my sea thoughts forever. Above water we often

witnessed forty-ton backflips and concluded that at a whale Olympics humpbacks would take gold medals in gymnastics.

During our dives we quickly grew accustomed to hearing the humpbacks' remarkable songs, but seeing a singer underwater proved to be an elusive goal. Al was the first among us to do it, and probably the first photographer ever to record the event on film. He, Chuck, and I went into the water close to where a singing whale had just submerged. Underwater the song was so intense that we could feel the sound as the air spaces in our heads and bodies resonated.

We settled to the bottom at a depth of 120 feet, and waited. Above us shafts of light beamed through indigo water, creating a cathedral atmosphere, while all around eerie "wheeeeps" and low rumbling sighs assailed our ears, our whole bodies.

Virtuoso Makes an Appearance

Fifteen minutes passed with no change in intensity of sound, and no whale. Then, as we returned to the surface, so did the humpback—a hundred yards away. Al decided to try again. Peter Tyack had been on the hydrophones, monitoring the whale, and Al said to him, "Keep listening. If I see the whale, I'll tap the camera so you'll hear it and know I'm filming."

Al went down again, and moments later Peter exclaimed, "He's tapping, and the whale is singing. Al's got it on film!"

Afterward Al described the singer—a soloist barely moving just under the surface, flippers down, emitting not one bubble of air as the song poured forth. At other times when we saw whales singing underwater, there again were no air bubbles, conclusive proof that expulsion of air is not necessarily a part of sound production.

Why the whales sing remains a mystery, but on one occasion Al witnessed some curious behavior on the part of a singer. One evening at dusk, while Roger recorded a song on the surface, Al located the singer some fifty or sixty feet down. As it sang, the whale lifted its great flippers forward, then back, in rhythm with phrases of the song. Of the seven singers we have watched underwater, it was the only whale that behaved that way. But the motion may be a common, though rarely observed, phenomenon.



Twice-told tail: Seen in both 1977 and 1978 in Alaska's Glacier Bay, Chop Suey, a whale named for its chopped-off dorsal fin, heaves distinctively marked flukes aloft as it sounds (above). The sightings

give evidence that at least some of Chop Suey's group of about 25 return to the bay for the summer feeding season.

The author also studied the whales as floating islands for plants and animals.



WOOD, BRANFLETT, COOK, MONTGOMERY, AND YOUNG. "CHOP SUEY," A WHALE WITH A CHOPPED-OFF DORSAL FIN, HEAVES DISTINCTIVELY MARKED FLUKES ALOFT AS IT SOUNDS. DIAMETER 2.5 IN.



Humpbacks may carry half a ton of barnacles, hitchhikers that fall off in warm waters. Flippers harbor goose barnacles (below, left), which grow double-decker on large acorn barnacles (below).



While the Paynes probed the hows and whys of whale sounds, I looked for evidence that humpbacks, other than nursing calves, feed in Hawaiian waters. Current theory holds that the whales eat during the summer and fall, storing up enough blubber to fast the rest of the year.

For months my colleagues and I watched humpbacks nearly all day, every day, but only twice did we see a whale lunge forward, mouth open, then expel water through the baleen plates attached to its upper jaw. Even then I could not be sure whether or not food was actually taken, and so concluded that if humpbacks feed in Hawaiian waters, they don't want anyone to know about it.

A Thousand Pounds of Freeloaders

My observations of whales as islands were more rewarding. At least two kinds of barnacles ornament the flukes, flippers, chin, and belly of Hawaiian humpbacks. One is the beautifully structured *Coronula*—a hard, white, calcareous kind that provides footing for soft, pink-and-brown goose barnacles (below, left). Al's season-long photographic record confirms Hawaiian biologist Dr. Paul Struhsaker's suggestion that the barnacles fall off in the warm water as the season progresses. Boat owners can be both envious and sympathetic: A single humpback may sometimes carry half a ton of these hitchhikers!

Among the free-swimming associates of humpbacks, we witnessed small fishes, pilot whales, spinner dolphins, and, most commonly, several bottlenose dolphins. On one memorable day Al and I went for a swim with some humpbacks and a group of spectacular companions. Skip Naftel, the captain of *Easy Rider*, had told of seeing humpbacks with pygmy killer whales on several occasions off the northern tip of the island of Hawaii.

Pygmy killer whales (*Feresa attenuata*) are rare and little known, but reputedly are aggressive creatures. The chance to see them with humpbacks was irresistible, and we all decided to investigate. With Skip as guide we set out one blustery day across the notoriously rough Alenuihaha Channel.

When we located the whales, the wind was blowing at 30 knots and the waves were cresting to 15

(Continued on page 14)







◀ **Dappled pair** of humpbacks courses through shafts of sunlight in warm Hawaiian waters (overleaf). Hugely benign and graceful, humpbacks tolerate author Earle and photographer Giddings as swimming companions.

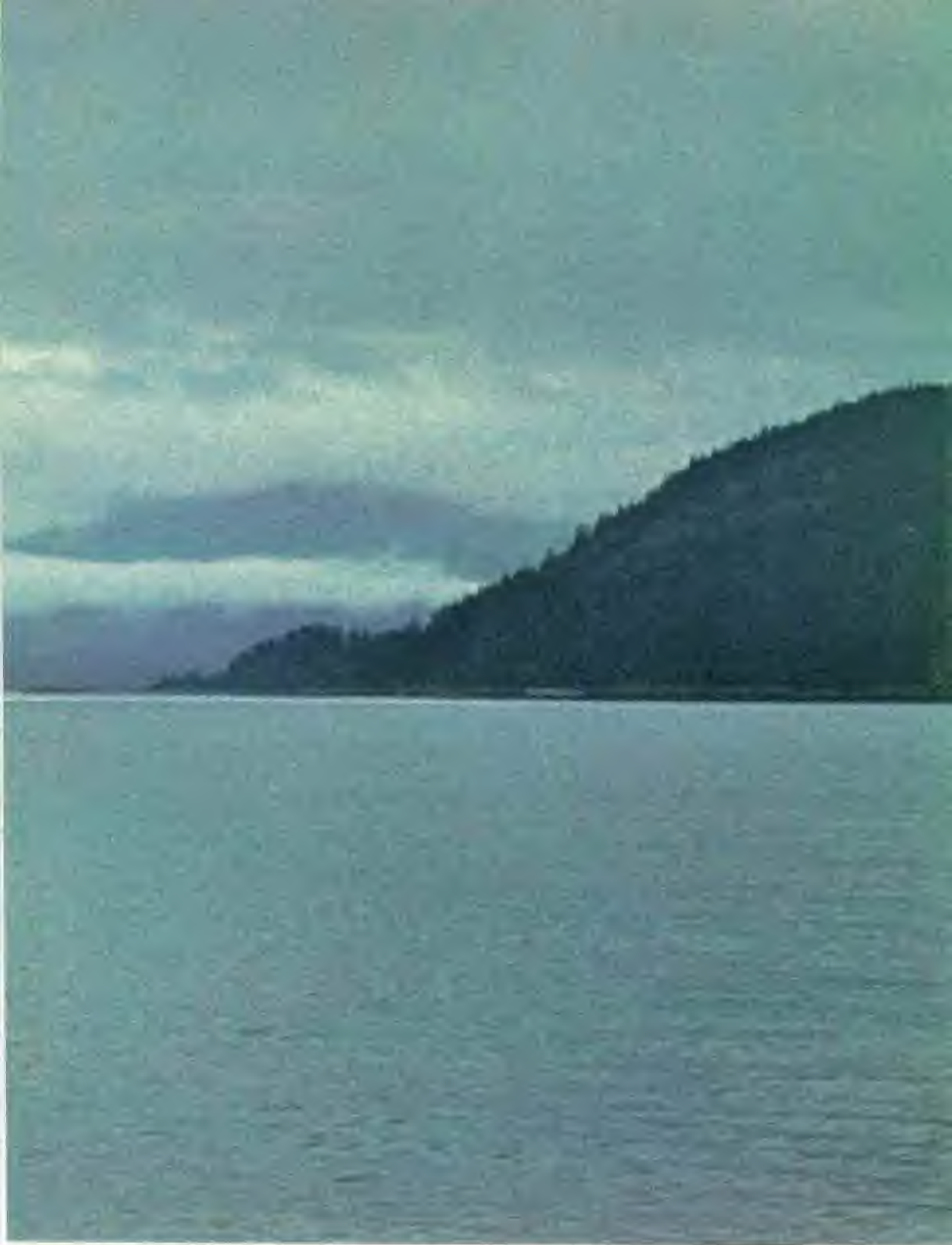
THIS PAGE FOLDS OUT

The silence is monumental until the whales begin to sing. Heard at close range, the songs are unforgettable—resonant and throbbing. “The sound was incredible, like drums on my chest,” says Giddings. PHOTO BY G. GIDDINGS/EVERETT

Backflip breach: A humpback hurtles skyward, splitting the calm waters of frigid Glacier Bay (above), summer home to this migrating mammal. Such wild gymnastics may serve as a means of whale-to-whale communication and as

a show of strength in response to a threat.

The power and majesty of whales fascinated American naturalist John Muir. On a trip to Glacier Bay in 1879 he described “their broad backs like glaciated bosses of granite heaving aloft



... and plunging down home. . . ." Due in part to his explorations, the bay and its surrounding ice fields, glaciers, and mountains were designated a national monument in 1925. Muir would surely be heartened by the current concern for

humpbacks, now a fully protected species by order of the International Whaling Commission. Perhaps 100,000 strong before whalers decimated their ranks early in the 20th century, humpbacks today number about 7,000.

(Continued from page 7) feet. As the humpbacks plowed serenely through the water, the pygmy killers broke through the waves next to them like gray torpedoes. Both seemed to enjoy the high seas, riding the waves, playing with the water.

Over the sound of the wind Al shouted, "Let's get in the water!" At first I thought he was joking, for I knew of no one who had deliberately dived in the wild with pygmy killer whales, let alone in the midst of a storm. But under the surface the sea would be calm, and I concur with Al's feeling about most sea creatures—if you mind your business, they will mind theirs. Over the side we went, into the gem-clear water.

As we got our bearings, we sighted about a hundred pygmy killer whales eighty feet below us, emitting staccato buzzing sounds and high-pitched squeals. They were moving in close formations of three to nine, side by side through the indigo sea.

So intent was I on watching the whales and trying to keep sight of Al that I failed to see the shark until it was nearly touching my flipper. It was a large oceanic white-tip and it was "breaking the rules"—making me *its* business. I kicked, and the shark darted away, then circled and came back. As I kicked again, a second shark arrived and moved in swiftly.

Then, quite suddenly, they were gone, leaving me with a curious feeling of having been inspected and found unappetizing.

Throughout the day we observed the humpbacks and pygmy killer whales swimming together in a rare commingling of these two quite different species. What either derives from association with the other remains a mystery, but there must be more to the phenomenon than mere chance.

Humpbacks May Migrate to Alaska

Toward late March the number of humpbacks around Maui diminished noticeably. Clearly winter was coming to an end.

Where do the humpbacks go when they leave Hawaii? No one knows for sure, though most scientists believe they travel north. By late April, Al and I decided to do the same. We took Roger's suggestion and set out for Glacier Bay, Alaska, to work with Charles and Virginia Jurasz.

For 12 years the Juraszes have observed

humpback whales in the waters around Juneau and Glacier Bay. So far there is no evidence that the humpbacks of Glacier Bay are the same as those from Hawaii, but a connection may one day be established.

The whales begin to arrive at Glacier Bay in May and June, as do numerous private and commercial boats bearing tourists, fishermen, and amateur whale-watchers.

Chuck and Virginia not only watch the whales, they watch the boats as well, to determine reactions of the whales to the sound, or simply to the presence, of such boats.

Where Does a Whale Sit?

There are no clear answers yet as to what disturbs a whale. One viewpoint was summed up by Sam Pyeatt, skipper of our ship *Sojourn*, who dismisses the idea that humpbacks take much notice of people. "That's why they're so vulnerable to whalers," Sam says. "They aren't accustomed to having enemies. I think humpbacks are like 500-pound gorillas: Where do they sit?—wherever they want to! I don't think they take people very seriously."

The Juraszes believe otherwise, and are gathering data for objective evaluation of whale behavior relative to human activity.

At Glacier Bay the family invited Al and me aboard their fifty-foot laboratory and home, *Ginjur*, and we were instantly immersed in the subject of whales. All the Juraszes are involved. Peter, 10, readily recognizes each of the Glacier Bay whales and serves as *Ginjur's* lookout. Susan, 16, has grown up with whales and has a study of her own in progress concerning breathing patterns of individual humpbacks.

"Eat and sleep—that's what the whales do here," Chuck explained to Al and me. "You're going to see a lot of both."

If anything, Chuck's remark was an understatement. Within a week we had witnessed several of the humpbacks' distinctive feeding techniques and had come within touching distance of whales asleep—sometimes accompanied by burbling, rumbling, whale-size snores.

About twenty-five whales enter Glacier Bay each summer, with about forty more occupying nearby bays and inlets. For years the Juraszes have kept a "fluke file" on each whale, often naming it for some distinctive

marking. The 1977 list includes Spot, a whale notable for the conspicuous white baseball-size mark on the underside of its tail; White-Eyes, with symmetrical white patches, albeit on its tail; and a companion nicknamed Dot-Dash, for the upside-down exclamation point on its fin.

Early in the season the only baby whale in the bay was a high-spirited calf whimsically called Garf, accompanied by his mother, Gertrude. In mid-August a second mother and calf arrived, and the newcomers sometimes swam with Gertrude and her son. We know Garf is a male because one day while he was rolling over and over at the surface, draping seaweed over his nose and flippers, we approached very close. On his underside we could see the position of the genital slit that confirmed he was indeed a he.

During the weeks of watching, we found that Gertrude and Garf always remained together. Sometimes the pair was accompanied by a third whale, perhaps the equivalent of the escort or so-called mystery whale that often accompanies a mother and calf in Hawaii. It was inevitable, I suppose, that the companion in this case became known as Garfunkle.

Ingenious Hunters Net Their Prey

The arrival of whales in Glacier Bay coincides with the long days of early summer, after blooms of microscopic algae and hordes of grazing zooplankton—crab larvae, copepods, and shrimplike krill—have begun to transform the waters of the bay into a rich, living soup. But, as in many soups, the tasty morsels in Glacier Bay are scattered and require several feeding strategies.

When Chuck Jurasz first told people that he had seen Alaskan whales blowing bubble “nets” to trap krill, few believed him. For the most part humpbacks feed by lunging forward and straining the minute zooplankton through sievelike baleen plates attached to their upper jaws. One morning aboard *Ginjar*, Al and I were watching a whale do just that, when Chuck shouted, “We’re headed right for a bubble net!”

As our boat edged past a circle of bubbles ten feet in diameter, a humpback surfaced in the center of the ring with its mouth open—just as Chuck had described. Apparently, to produce a bubble net, the whale dives



Grabbing a free ride, a porpoise cruises the bow wave of the humpback at right. Thus porpoises may have learned their shipside acrobatics, one scientist theorizes. Humpback companions include pilot whales and pygmy killer whales. Why? “It’s a mystery,” says the author. “They may simply enjoy each other’s company.”



KRILL: *EUPHYASIA PACIFICA*, 1/18

Jonah-size maw: Its throat ballooning into a huge pouch, a humpback gulps a seawater bouillabaisse, to be strained by fringing baleen for its prime staple of krill, tiny shrimplike crustaceans (left). An adult's stomach can hold as much as 1,300 pounds of food. Greenish patches inside the krill result from plankton they feed on. The food-chain equation: Roughly a hundred pounds of plankton yields ten pounds of krill, which yields one pound of whale.



beneath its prey and, swimming in an upward spiral, releases bubbles that rise to the surface. Small schooling fishes and krill are thus concentrated and contained to be devoured in a gulp (pages 20-21).

Some such technique is important to a successful hunt, for despite their minute size the krill are fast moving, as I discovered when I tried my hand at netting them. Using a fine-meshed dip net, I scooped in the water where we could see krill swimming. My score after thirty sweeps was a meager three specimens. At length I gave up, glad that unlike humpbacks I didn't have to depend on krill for my meals.

Later I tried scooping krill at the surface inside a whale's bubble net. Suddenly I was krill rich. Each dip yielded dozens, sometimes hundreds, of the tiny creatures.

From the standpoint of krill, humpbacks are fierce, aggressive predators. Yet to us they seemed gentle and placid, avoiding contact with our boat even when we drifted in the midst of several wide-open mouths. Such gentleness enabled me to inspect whales literally at arm's length, and I was able to verify that humpbacks in Alaska are hosts not only to barnacles and algae but also to whale lice—small pale-pink amphipods that cling to the whales' hides.

Such encounters made me understand why humpbacks have been reduced to near extinction by hunters: They are easy, accessible prey. In less than a century we have traded sixty million years of history for margarine and cat food. Populations of Southern Hemisphere humpbacks—biologically comparable to races of human beings—have been nearly, perhaps wholly, exterminated.

No Substitute for the Real Thing

With the decline of whales, alternatives have been found for their oil, meat, baleen, and bone. It is said there is nothing that comes from a whale that cannot be synthesized. I told my children this, and their reaction was immediate: "What about baby whales? And bubble nets? What else can do forty-ton backflips and sing?"

They have a point. There are substitutes for whale products but none for whales themselves. We dream of communicating with intelligent life in space. But I wonder how this goal can be attained when we have not yet achieved peaceful rapport with whales, gentle earth creatures that even share our mammalian heritage.

If whales someday are gone, also gone will be the opportunity to learn how these warm-blooded animals survive in cold seas, communicate with song, and navigate across thousands of miles of ocean with no road map, no lunch.

Gone, too, will be the poetry, the symbol that whales provide for us. By respecting their right to live and to coexist peacefully with us, there is evidence that we can find harmony with our environment, our fellow creatures—and perhaps with ourselves. □

HUMPBACKS: Their Mysterious Songs

By ROGER PAYNE, Ph.D.

Photographs by AL GIDDINGS

SEA FILMS, INC.



DRAWING BY RICHARD SCHICKEL

AT DUSK I SAT in the stern sheets of our small sailboat, braced against a stanchion and using the last light of day to take a final sight on Bermuda's Gibbs Hill Lighthouse, 35 miles to the northeast.

We were too far from land to return that evening; my wife, Katy, and I would have to spend the night at sea. Bermuda's treacherous reefs are difficult enough to navigate in broad daylight. In darkness they are impossible.

As night deepened, a familiar feeling came over me, one of loneliness at sea. I felt at one with the other solitary watchers elsewhere on earth—the shepherds, sentinels, and herdsmen who huddled alone beneath these same stars, feeling the night close in around them.

To break the mood, Katy and I got down to work. We brought the boat about onto the other tack and pointed her as high into the wind as we could, so that she nodded gently with the waves. After lowering a pair of hydrophones into the sea, I switched on their amplifiers and listened in stereo through the headphones.

We were no longer alone! Instead, we were surrounded by a vast and joyous chorus of sounds that poured up out of the sea and overflowed its rim. The spaces and vaults of the ocean, like a festive palace hall, reverberated and thundered with the cries of whales—sounds that boomed, echoed, swelled, and vanished as they wove together like strands in some vast and tangled web of glorious sound.

I felt instantly at ease, all sense of desolation brushed aside by the sheer ebullience of it all. All that night we were borne along by those lovely, dancing, yodeling cries, sailing on a sea of unearthly music.

Often during that night off Bermuda I thought how the oceans had once heard these wild cries. How, once, the echo chamber of the sea had reverberated to the haunting "songs" of whales. Then I thought of what it is like today in many of the whales' former haunts—silent, lifeless, impressing one most with a sense of what has been lost.*

*The author's articles include "At Home With Right Whales" in the March 1976 NATIONAL GEOGRAPHIC and "Swimming With Patagonia's Right Whales" in the October 1972 issue.

Humpback whales pass Bermuda each spring on their way north from southern calving grounds near Puerto Rico. During this period the humpbacks fill the ocean with complex and beautiful sounds. Many hours of these sounds were recorded and later analyzed with the help of a friend, Scott McVay, at Princeton University. The analysis showed that humpback sounds are in fact long songs. I use the term song not in a sense of beauty, although humpback sounds are indeed beautiful. By song I mean a regular sequence of repeated sounds such as the calls made by birds, frogs, and crickets.

Humpbacks Change Their Tune

Most birdsongs are high pitched and last only a few seconds, while humpback songs vary widely in pitch and last between six and thirty minutes. Yet if you record a whale song and then speed it up about 14 times the normal rate, it sounds amazingly like the song of a bird. In the second selection on side one of the detachable sound sheet included with this article (pages 24A and 24B),* you will hear that striking similarity.

When you go out to listen to a humpback sing, you may hear a whale soloist, or you may hear seeming duets, trios, or even choruses of dozens of interweaving voices. Each of those whales is singing the same song, yet none is actually in unison with the others—each is marching to its own drummer, so to speak.

The fact that whales in Bermuda waters are singing the same song at any given moment is not surprising when you think of how similar two robins or two cardinals sound. But if you collect humpback songs for many years and compare each yearly recording with the songs of earlier years, something astonishing comes to light that sets these whales apart from all other animals: Humpback whales are constantly changing their songs.

In other words, the whales don't just sing mechanically; rather, they compose as they go along, incorporating new elements into their old songs. We are aware of no other animal besides man in which this strange and complicated behavior occurs, and we have no idea of the reason behind it. If you listen to songs from two different years you

will be astonished to hear how different they are. For example the songs we taped in 1964 and 1969—both of which can be heard on the enclosed sound sheet—are as different as Beethoven from the Beatles.

By combining our own tapes with those of friends like Bermudian Frank Watlington, we now have a sample spanning twenty years in Bermuda.

Katy and I have analyzed this data in detail. We find that the song has been constantly changing with time. All the whales are singing the same song one year, but the next year they will all be singing a new song. The yearly differences are not random, however. The songs of two consecutive years are more alike than two that are separated by several years. Thus, the song appears to be evolving, but regardless of how complex the changes are, each whale apparently keeps pace with the others, so that every year the new song is the only one that a listener hears.

Musical Talent May Be Inherited

We have also recorded and analyzed four years of humpback songs from Hawaii, a major wintering area for humpbacks. Although songs of the same year in Hawaii and Bermuda are different, it is intriguing that they obey the same laws of change, and have the same structure. Each song, for example, is composed of about six themes—passages with several identical or slowly changing phrases in them. Each phrase contains from two to five sounds. In any one song the themes always follow the same order, though one or more themes may be absent. The remaining ones are always given in predictable sequence.

The whale populations of Hawaii and Bermuda are almost certainly not in contact. Thus, the fact that the laws for composing the songs are the same in both places strongly suggests that the whales inherit a set of laws and then improvise within them. Whether these laws are transmitted from one generation to the next genetically or by learning remains to be seen. When Katy first

*Longer samples of humpback whale songs can be heard on two albums produced by Capitol Records, Inc.: "Songs of the Humpback Whale" (SW-620), and "Deep Voices" (ST-11598). Artists' royalties go to the New York Zoological Society's Whale Fund.





Ingenious hunter solves the problem of herding scattered morsels into a bite-size feast by blowing a bubble "net." Like a giant undersea spider spinning its web, the humpback begins perhaps fifty feet deep, forcing bursts of air through its blowhole while swimming in an upward spiral (left). Big bubbles, followed by a mist of tiny ones, rise to create a cylindrical screen that concentrates krill and small fish. Bubbles and food pop to the surface (above), followed by the gaping mouth of the whale (right) as it emerges in the center of its net. Charles Jurasz, who discovered that Alaskan humpbacks make bubble nets, says that two animals sometimes collaborate on a net perhaps a hundred feet across.

Dr. Payne has spent 12 years studying the sound sequences in the humpbacks' rhapsodies and has worked with Jurasz to analyze noise patterns produced as they blow bubble nets. "It appears that the whales can select the size of the bubbles; they can make their nets any size 'mesh' they want," the author believes.

An alternate tactic called "flick feeding" has also been observed, during which the whales splash water over their heads with their flukes so that it lands in front of them as they swim. The impact of the water startles krill long enough for a quick gulp. Humpbacks may also use their flippers—longest of any whale species—to scoop their prey into the path of their mouths.



PAINTING TOPPOSITE BY RICHARD SCHUECK



Flurry of flukes draws a surge of tourists to the rail of a cruise ship in

discovered that the songs of humpbacks were changing from year to year, a simple explanation seemed likely: Since the whales do not sing at their summer feeding grounds, and since the song is complex, perhaps the humpbacks simply forget the song between seasons and improvise a new version from whatever fragments they can recall.

To test this theory, we organized a season-long study of humpbacks off the island of Maui in Hawaii.

The study had two objectives: to record a full season of songs and to make observations of the whales' behavior.

We were joined in the study by Al Giddings and Sylvia Earle, two of the most experienced divers in the world. Al, with

his unsurpassed ability as an underwater photographer, and Sylvia, with her background in both diving and science, were ideal partners, as were our two graduate students, Jim Darling and Peter Tyack.

Songsters Pick Up Where They Left Off

To me, the results of the study are fascinating. Over a six-month period we obtained samples of songs, coupled with unique observations of underwater behavior. The subsequent analysis of our tapes has revealed an intriguing fact: The whales had not forgotten the previous season's song, for they were singing it when they first returned to Maui. Only as the season progressed did the changes gradually take



Glacier Bay. In small boats, whale-watchers can harass the creatures.

place. Obviously, during the period between breeding seasons the song is kept in "cold storage," without change.

Another fascinating thing we discovered is that the whales always sing new phrases faster than the old ones. We discovered, too, that new phrases are sometimes created by joining the beginning and end of consecutive phrases and omitting the middle part—just as we humans shorten "do not" to "don't." In many other ways the introduction of new material and the phasing out of old are similar to evolving language in humans.

So far, the study of humpback whale songs has provided our best insight into the mental capabilities of whales. Humpbacks are clearly intelligent enough to memorize

all the complicated sounds in their songs. They also memorize the order of those sounds, as well as the new modifications they hear going on around them. Moreover, they can store this information for at least six months as a basis for further improvisations. To me, this suggests an impressive mental ability and a possible route in the future to assess the intelligence of whales.

Songs are not the only vocalizations of humpbacks; we often hear grunts, roars, bellows, creaks, and whines. These sounds sometimes accompany particular types of behavior, suggesting that they may have specific social meaning.

One such association between sound and behavior has been documented by Charles

Symphony of the Deep: "Songs of the Humpback Whale"

THE SOUND SHEET facing this page contains a unique concert composed and orchestrated by one of earth's largest and most endangered creatures. The humpback is the only whale known to emit underwater sounds in the form of "songs"—long, complex sequences of repeated phrases.

Roger Payne, author of the accompanying article, has studied whale songs with his wife, Katy, for more than a decade. With support from the National Geographic Society and the New York Zoological Society, the Paynes recorded all but one of the songs on this sheet. Selection 3, side one, was recorded by

Frank Watlington, an acoustical engineer at Columbia University's Geophysical Field Station in Bermuda. Selection 2 is a speeded-up version of that song. The sound of a humpback blowing a "net" of underwater bubbles to trap food was recorded by Al Giddings for Survival Anglia, Ltd., of England.

The Paynes conduct their research in Bermuda and Hawaii, both singing grounds of the humpback. "The Bermuda and Hawaii songs are different," Dr. Payne observes, "but all humpbacks in each area sing only the local song."

To introduce these remarkable songs to its members, the Society ordered ten and a half million copies of the sound sheet, the largest pressing ever published. *Remove the sheet carefully by pulling straight out from the binding, and play it manually at 33 1/3 rpm. The sound sheet is in stereo but will play satisfactorily on any phonograph.*

Because humpback whale songs are among the loudest sounds made by any animal, you will experience the "presence" of the whale best by playing the sound sheet at louder than usual volume.

For Roger Payne the songs symbolize both the majesty and the fragility of the sea. "We have learned," he says, "that all men are created equal, but the whales remind us that all *species* are created equal—that every organism on earth, whether large or small, has an inalienable right to life.

"Our belated concern for whales is helping to save them from extinction by commercial hunting, but how are they to survive if we destroy the oceans themselves? Pollution has replaced the harpoon as a mortal threat to whales, and in its way can be far more deadly. If we ignore the dangers of tanker spills, industrial contamination, and simple human carelessness, then nothing can save the whales. If that day ever comes, the exquisite songs you hear on this sound sheet will be voices not from the sea, but from the past."



NATIONAL GEOGRAPHIC PHOTOGRAPHER JOE BRADLEY

Orchestrating a whale concert, Dr. Payne, left, and Jon Larimore, manager of the Geographic's Audiovisual Services Division, produce the master tape.

Jurasz, an independent researcher in Glacier Bay, Alaska, whose observations on "bubble netting" Sylvia Earle describes in the previous article. Chuck's 12-year study has added significantly to our knowledge of whales. On a recent visit with Chuck I recorded the underwater sounds of a humpback in the act of "spinning its net." Such sounds, which can be heard in the first selection of side two on the sound sheet, consist solely of expelled air. There are no accompanying social or vocal noises, which suggests to me that bubble netting is a deliberate act—that of a whale setting a trap.

Are We Killing Whales With Kindness?

Only a few years ago the chief threat to humpback whales was the men who hounded them dangerously close to extinction. Today international agreement forbids the killing of humpbacks, but in some areas man threatens to love them to death.

In Hawaii increasing numbers of well-meaning tourists now converge on the breeding grounds in small boats to observe and photograph the great creatures at close range. Observation can sometimes edge over into harassment, which is illegal under both the Marine Mammal Protection Act and the Endangered Species Act.

In 1976 I tackled the problem with Nixon Griffis, a longtime friend of humpbacks. Together we called on Elmer Cravalho, mayor of Maui County, who appointed Jim Luckey, manager of Maui's Lahaina Restoration Foundation, to be chairman of a citizens' committee to explore the problem. The result is an official organization to educate the public and so prevent harassment of the whales. Thus the citizens of Maui have taken a major initiative in generating local government and citizen concern for protecting a marine mammal on the endangered species list.

Plans are now under way to establish a Pacific Marine Research Center at Lahaina with support not only from Hawaiians but also from worldwide subscription.

Happily for whales, such efforts are on the increase. One recent development may have spread the songs of humpbacks not just from the oceans to the land, but throughout the galaxy. In late summer of 1977, Voyagers 1 and 2—spacecraft launched from Cape

Canaveral, Florida, toward other worlds in our galaxy—carried aboard unique recordings that included the works of Bach, Mozart, and a rock group, as well as a section entitled "The Sounds of Earth."

In the latter section delegates from 60 member countries of the United Nations offered a greeting in 55 languages. The messages were followed by a somewhat longer "greeting" from a humpback whale, recorded by Katy and me off Bermuda in 1970. In some ways this constitutes a step beyond all my dreams, in seeing whales become a symbol for the hope that there is still intelligent life on earth.

The expected lifetime of the records is a billion years. Should they be encountered by some other space-faring civilization, they would bear a message that had lasted longer than perhaps any other human work.

Could it be that mankind is simply the humpbacks' guarantee that its songs will be heard throughout the galaxy? □



Following humpback "scores" on charts called spectrograms, Katy Payne, the author's wife, found that the whales compose new songs each year, improvising on their old ones—an indication of uncanny intelligence.

Los Angeles: City

By WILLIAM S. ELLIS

RAIN FELL AGAIN, in the morning, and before another dawn, juggernauts of mud were moving down the hills and through the valleys, burying houses and horses and tons of automobiles.

Not many miles away, the surf of the Pacific sucked sand from beneath million-dollar beach dwellings until the plumb lines of good construction collapsed in fits of wrench and warp. And it rained the next day, and the next, and on through the week.

This city, I thought, is going to wash away. All the swimming pools and tennis courts and silver Rolls-Royces—all are going to be launched on a journey toward the setting sun, and with them will go all the tequila and unruly enchiladas.

If that happened, I thought too, would they cheer, those of great number who regard this place as somewhat of a pariah? They are everywhere (even here), and when they pass judgment, it is a litany drawn from a widespread image of a shapeless city sprawled to a fare-thee-well in all directions, either baking under the southern sun or drowning in the unmerciful rains, choking on its smog, in bondage to its automobiles, hung with tinsel, flauntingly sinful.

And so the hisses are heard, but hear too this hosanna: Los Angeles is a bold and innovative sprinter in a field of metropolitan plodders. (A taxpayers' revolt spawned in this city only recently sent shock waves across the land.) *(Continued on page 34)*

The face is familiar, but the name's not the same. These people get paid just for looking famous. Doubles of Shirley Temple, Gerald Ford, Candice Bergen, Henry Kissinger, Raquel Welch, and Jimmy Durante stroll Sunset Boulevard in Hollywood, the Los Angeles district where illusion is a very real commodity.

MODEL COURTESY BOB SMITH'S CELEBRITY LOOKALIKES



in Search of Itself

Photographs by JODI COBB

ROYAL NATIONAL GEOGRAPHIC STAFF









Destiny manifests itself as an awesome sprawl called L.A.—magnet to migrants from other states, from south of the border, and from the Orient. After filling the Los Angeles Basin, the influx spilled into nearby valleys and beyond. Seemingly boundless acreage and a 13-story limit in this land of earthquakes helped create a megalopolis without a skyscraping center. But mounting land costs and improved design and construction have lifted that ceiling. Now high-rise hotels and office buildings sprout in a

late-blooming downtown (center, overleaf). In pernicious alchemy, the golden California sun transforms fumes from millions of vehicles into L.A.'s most infamous coinage: smog. Last July, a sunset behind downtown towers cast a dreamlike aura during the worst week of air pollution in city history (above). Capricious nature follows drought with deluge to create another nemesis: mud slides (following pages). Mayor Tom Bradley, right, inspects a home that slid in value from \$194,000 to zero in one wet weekend.





(Continued from page 26) It sets tone and style for much of the country, and wherever other cities may go, Los Angeles is likely to have been there before. It is, for good or ill, the ultimate city of the 20th century.

Metropolis Spread Flat and Wide

Well, Los Angeles survived the drenching, muddy winter of last year. "And now that that's over," a gardener commented while plucking offensive growths from the earth, "we can get back to worrying when the next earthquake will hit."

He was grooming an estate in the Hollywood Hills, and, if he cared to, he could look out over the whole outrageous sweep of this

onetime Spanish settlement of just 11 families. He could look to the south where the municipal boundaries trail off into a kite tail to the ocean, to the north and west where the city spills into the San Fernando Valley, and east to downtown Los Angeles and its cluster of tall buildings. It was all below him, tied and knotted in freeways and garnished with the greenery of palms.

So Los Angeles *does* have defined boundaries (map, page 36). It is true that they trace a pattern of spilled quicksilver, but they are there nonetheless, encompassing more than 460 square miles. Nearly three million people live there. Only New York and Chicago in this country have more.

Some came in the 1930's, in pickup trucks powdered with the dust of the plains. Still others came in the 1940's because there were wartime jobs to be had, and when the fighting stopped, they came as veterans remembering a furlough in Hollywood or the warmth of the sun as it shafted through the grimy window of a troop train.

Now, however, they come mostly from the south, from Mexico. The influx is massive but orderly, a tiptoe invasion transforming Los Angeles into a predominately Spanish-speaking city. The development has been called "another Quebec," where French is today the official language.

Legal or Not, Here They Are

It is hard to tell how many people with Spanish surnames now live in Los Angeles proper, for many are there illegally. The figure most often cited is a million, with at least 400,000 having crossed the border without proper documents. Certainly Hispanics are in the majority among those enrolled in the city's public schools.

"I guarantee you that by 2000 we'll have a Spanish-speaking mayor of Los Angeles and at least three Spanish-speaking city councilmen." Alberto Juarez raised his voice as he spoke, partly out of emotion, I suspect, and partly because of the noise in the Mexican eatery where we sat in a booth flecked with rice and half a dozen beans gone astray. "No one is sure about the number of undocumented aliens here now, but I do know that in all of Los Angeles County there are upwards of two million Mexican-Americans. That's better than a quarter of the county's



Things go better with water that's been cleansed of the chlorine and salts found in the tap flow. A vending machine in front of a market offers purified water and the same product with some minerals added for flavor. Though local water doesn't taste all that bad, the area leads the U. S. in per capita sales of bottled water, largely because of aggressive marketing by the nation's two largest water companies, both based in southern California.

population. By the year 2000 it may well reach more than 50 percent."

Juarez is a former executive director of the One Stop Immigration Center, a nonprofit organization set up to provide legal and social services for aliens in the Los Angeles area. He is a third-generation American of Mexican heritage, and, at the age of 37, a man with a drive and determination pricked by the fires of protest.

"Passage across the border cannot be stopped, certainly not as long as the economies of the two countries have such a disparity between them," he said. "We're only 120 minutes away from the border by car. You know what happens on a Saturday night when a Mexican fighter has a bout in Los Angeles? They come up in caravans."

Machismo Rules the Barrios

Ironies abound in the Hispanicization of Los Angeles. Many—probably most—illegal aliens pay their federal income taxes, studies have shown, but few apply for welfare and other aid for fear of being apprehended. Also, the Mexican husband is a prideful man, reluctant to seek help.

Machismo. It is stamped on the barrio of East Los Angeles like a signet of majesty. And sometimes it is defended unto death, for along those seemingly peaceful streets with hibiscus in the yards roam gangs of youth. *Cholos* they are called, and now and again they do violent battle with each other.

The car, a red Rambler sedan, was unmarked, but those who watched it roll along East First Street in the Boyle Heights district of the city—they knew. Indeed, the very starkness of the car—no chrome trim, no whitewalls—was like a flashing beacon announcing "police."

"There are at least 13 major gangs here in East Los Angeles, and 20 or 30 minor ones," Sgt. Richard Kalk told me as his partner, Sgt. John Colella, turned the Rambler onto a hillside street. "It was on this street that the first homicide of 1978 occurred in Los Angeles. A member of a gang shot a member of a rival gang with a 30-caliber rifle. He died two minutes past midnight on January 1."

Kalk, who has consulted on movies and television shows about police work in Los Angeles, and Colella are homicide detectives attached to the Hollenbeck Division

station in the heart of the barrio. It is a job of frustrations and heartburn, of tacos for lunch and fruitless interrogation. Witnesses refuse to talk for fear of gang reprisals.

"There is one gang member here who has committed about eight murders," Colella said. "And he is still walking the streets, because no one will testify against him."

Apart from the gangs, however, crime is actually subsiding. Says Capt. Rudy De Leon, commander of the station: "There are 200,000 people in our district, and at least half of them are illegal aliens. That's a 250 percent increase over the past five years. There's also a drop in crime over that period, and I believe it is because the average illegal alien will not risk being caught and sent back by breaking the law here."

An aura of tranquillity pressed down on surrounding streets until parts of East Los Angeles seemed to have been transported to some gentle farmland setting where pies cool on windowsills. The stucco houses stood in good repair, and the recent rains had brought a lushness to the lawns. On one block a young man of dark complexion walked slowly, stopping to read each house number. He carried a suitcase—laboriously, as travelers do near journey's end.

Before the porch of a single-story house, he dropped the bag and ran into the open arms of a woman at the door. Others emerged to embrace him. They went inside, and ten minutes passed before a boy of maybe 10 years came out to retrieve the bag.

Be Back for the Weekend, Amigo

Undocumented alien newly arrived? If so, he might work in the garment industry, or in a hotel or restaurant. Perhaps he would be swept up in one of the frequent raids conducted by the U. S. Immigration and Naturalization Service (pages 40-41). But deportation is not necessarily permanent.

"About 95 percent of deportable aliens who are apprehended waive their right to a hearing and choose to leave the country voluntarily," Robert J. Seitz, a spokesman for the service, said. "But we get a lot of repeaters. Sometimes they are back so soon that they miss only two days of work here."

Yes, deported on Wednesday and back in time to join the weekend parade along Broadway. It is a street in downtown Los

Los Angeles

Harlequin quilt of a satellite's view shows the varied textures of the nation's third largest city. Scientists analyzed data based on reflected light to identify various land uses, which were then color-coded (key, below).

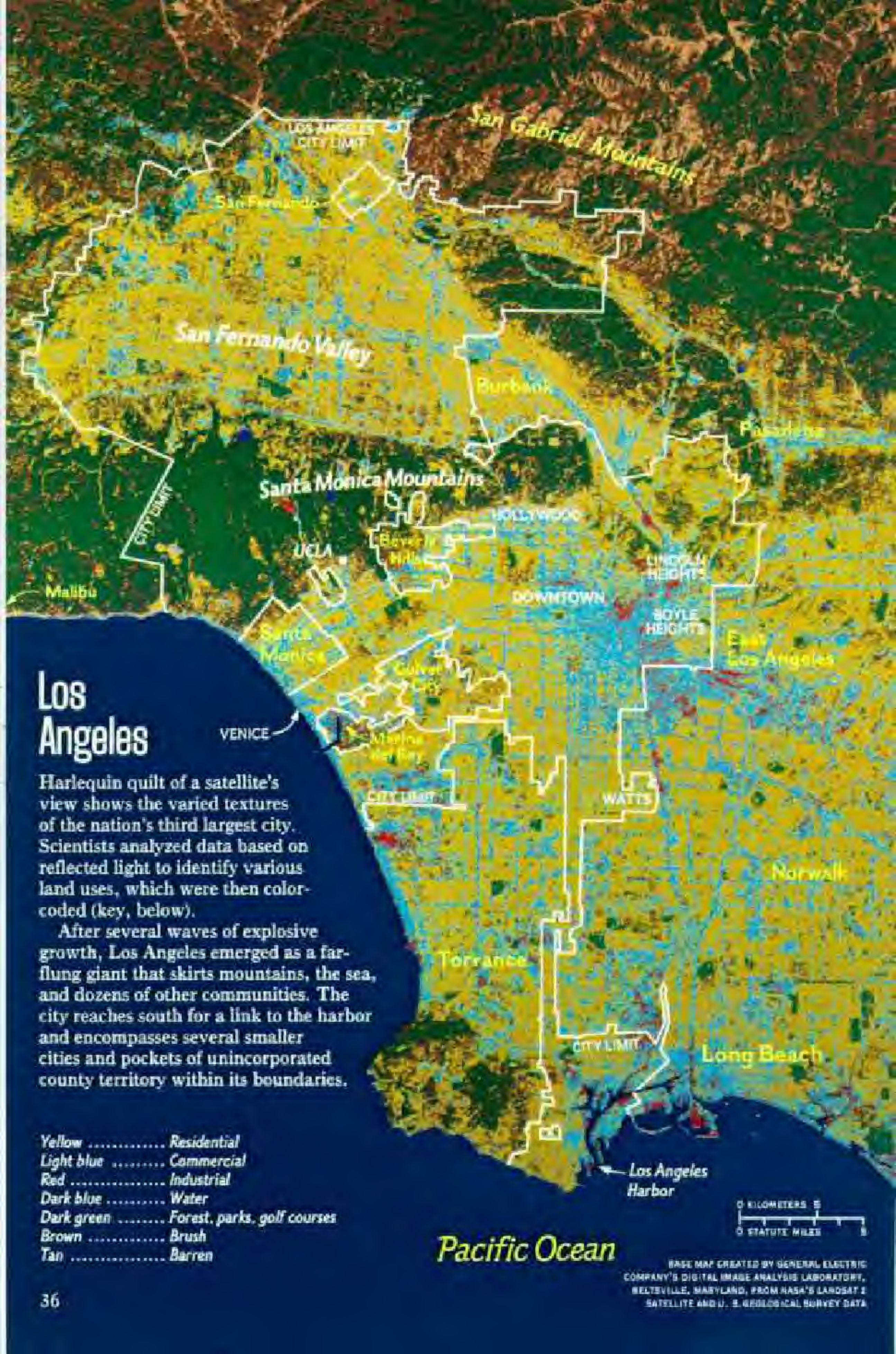
After several waves of explosive growth, Los Angeles emerged as a far-flung giant that skirts mountains, the sea, and dozens of other communities. The city reaches south for a link to the harbor and encompasses several smaller cities and pockets of unincorporated county territory within its boundaries.

Yellow	Residential
Light blue	Commercial
Red	Industrial
Dark blue	Water
Dark green	Forest, parks, golf courses
Brown	Brush
Tan	Barren

Pacific Ocean



BASE MAP CREATED BY GENERAL ELECTRIC COMPANY'S DIGITAL IMAGE ANALYSIS LABORATORY, BELTSVILLE, MARYLAND, FROM NASA'S LANDSAT 2 SATELLITE AND U. S. GEOLOGICAL SURVEY DATA



Angeles, this Broadway, and Saturdays and Sundays it is freighted with a vast, colorful outpouring of Hispanic life. They are there mostly to shop: for the clothes hung on sidewalk racks, for the shoes heaped in bins, for the records of Spanish music blaring from shops, for knobby roots and other exotic edibles, for crucifixes and knickknacks.

"Broadway," said a city government worker, "is probably the largest ethnic shopping center in the country today." In addition to large numbers of Mexicans, there are many Guatemalans, Colombians, Salvadorans, and others from Central and South America as well as the Caribbean. The street and those who walk on it stand as the most visible indicator of where Los Angeles, as a city in search of itself, is headed.

It is headed back to its roots.

Missing: A City Nucleus

Nearly 200 years have passed since the 11 families, 44 persons in all, established their settlement following the trek from Mexico. They marked off the plaza of their pueblo on a site just northeast of today's Civic Center complex in the downtown area, and it was there that Los Angeles was born.

They came to farm, and the farms became ranches, and the ranches provided food for the hordes of gold seekers to the north. The railroad completed its link to Los Angeles in 1876, and many others were lured west by the cheap fares.

Through all that, the city's growth was outward and flat, the growth of dough under a rolling pin. So it was too with the great expansion and influx of new people following World War II. The room for spread was there, and no matter that it meant traveling long distances by car on crowded freeways; Angelenos seem to *enjoy* that.

It became a city without a core or theme, a city of invisible cityness. The sense of neighborhood arose not from cells of city blocks but from chunks of the suburban sprawl.

Ultimately, of course, the outward tide had to slacken. Population growth fell off after a severe earthquake in February of 1971. The rev of this huge machine of a city slowed. But one section of Los Angeles was undergoing a dramatic resurgence, and there would be no stopping that: Downtown had finally emerged as a portrait on the

skyline, a vertical thrust from the most horizontal of our major cities (pages 28-30).

There had been tall buildings before 1971, of course, and these survived the quake. Now they were joined by other massive pinnacles, one of them 62 stories high: new hotels, a convention center and world-trade center, department stores, a center for the performing arts—all that and more.

The investment has amounted to more than a billion dollars, and what that money has brought about, in addition to the cosmetic changes, is an element of corporate imperiousness in the character of the city. For, among other things, the new downtown embraces a major financial center large enough to take over San Francisco's role as leading money changer in the West. So here the suede and denim casualness of the city gives way (to a certain degree) to the suit and vest, the briefcase, and the unsmiling perusal of computer readouts.

But this is still Los Angeles, and one need walk only two or three blocks from the skyscrapers with their tinted opaque glass to find the most casually attired of all those who live in the city. Skid row is there, home to ten thousand derelicts.

Trash Brigade Out in Force

For the homeless, Los Angeles is a favored city. One seldom needs a heated grate for sleeping, or the Army greatcoat, long-time skid-row fashion in colder climate. Somehow, with his tan and his great growth of hair—what is the explanation for the rarity of baldness among residents of skid row?—the derelict in Los Angeles appears to be a healthier specimen than his brethren elsewhere. One is struck, too, by the number of women who work the trash baskets and doze in the musty hallways.

There was one I saw every day for almost a month. She was of age between 35 and 40, and she always wore the same clothes. Her shoes were pink ballerina slippers, and it was easy to see they were too small, because her toes were bunched up in knots the size of lemons. Her blue nylon jacket was too big, and so were the dungarees and the faded, torn blouse.

Yet she walked with a certain dignity. And one day, when she stopped me to ask for a cigarette, I noticed her hands. They were





pale and smooth—the hands of a contessa—and the long, slender fingers tapered off to flawlessly polished nails. Those hands graced that haggard body as the eyelashes of a giraffe grace that silly face.

"You have beautiful hands," I told her, hoping she would reveal herself to be the daughter of a pretender to the throne of some abolished monarchy in Eastern Europe.

"Yeah, well you see, honey, I don't do a lot of dishwashing."

Series of City Centers Envisioned

Downtown redevelopment is pushing in on skid row, and eventually the ten thousand may be forced out. There are ambitious plans to further transform downtown into a city core of strength and vibrancy. Los Angeles, however, is so vast—at some points 48 miles across—that adjustments have to be made for the many tens of thousands of residents who rarely venture beyond their suburban communities. To them, downtown consists of the closest shopping center.

"We hope to create 28 living and working centers in the city, all connected by a rapid-transit system," said Calvin Hamilton, director of the Department of City Planning. "With these miniature central areas the people can still have the Los Angeles life-style. But this will also reduce the necessity for cars, and that will reduce pollution."

Hamilton explained that the units will offer a variety of housing patterns, such as town houses, three-story walk-ups, and high-rise apartment buildings. Essential to the plans is the preservation of "open space," or parks, in the city. And Los Angeles is a city of parks, one of which alone—Griffith—covers 4,064 acres. No other city-owned park is as large.

"The citizens want to protect the life-style they came out here to enjoy," Hamilton said. "They want space, a choice in housing.

Priming the pride of the city's largest ethnic group, a 90-foot mural depicting North American Hispanic culture graces the side of a Lincoln Heights bank. The last panel (left) presents scenes from Mexican life in the U.S. If present trends continue, the majority of Angelenos will bear Spanish surnames by century's end.





Revolving door between two nations, the city is plagued by an endless cycle of apprehension, deportation, and reentry of illegal Mexican aliens that overtaxes U. S. immigration agents. In one day agents netted 45 workers at a mobile-home factory in suburban Norwalk. If the faces of these men arrested in that raid lack anguish (above), it's because many know they'll be back at the same job shortly. During the Norwalk raid, inspector Bill Kee stands with handcuffs ready after flushing out a suspect from a

specially made hiding place (above, left). Another common scenario: Something changes hands as a suspect is led away (left). It could be keys to a car entrusted to a co-worker, wages earned, or fare for the return bus trip. Estimates of the number of illegal aliens in Los Angeles range upward from 400,000. If all were permanently deported, the area's hotel, restaurant, and garment industries would be paralyzed. Asked to describe his job, one agent said: "It's an exercise in futility."

So we have to plan with that in mind."

A more compelling consideration to be made in planning for this city is the problem of too many cars and too much pollution. On some days the problem rears up like a disturbed dragon, spewing a foul, fiery breath.

On a day, for example, like that Thursday when the old man played the harmonica while driving on the Hollywood Freeway.

From the time it came up that day, the sun was but a cataractous eye, a reddish smear in the smog. By midmorning the air was like mustard gas. Nothing stirred up there. As the day aged, it became worse. Around five o'clock, Los Angeles lay etherized under a layer of smog so thick and noxious that even those with *healthy* hearts and lungs were cautioned to stay indoors.

At that time, too, the traffic on the Hollywood Freeway was backed up for many

miles. The vehicles moved all right, but in ten-mile-an-hour spurts. Motorcycles weaved through the lanes, setting off fits of barking by dogs in pickup trucks. There were accidents, and cars overheated and stalled. Those that continued to run fed that yellowish monster hovering overhead.

I traveled less than ten miles on that freeway, and it took an hour. As I neared the exit ramp, the traffic was once again stopped. It was then that I saw him, the old man. He pulled his car alongside mine, and when I looked over, I saw that there was a harmonica held in front of his mouth by means of a metal support worn around his neck. Then, with both hands still on the wheel of his car, he started to play, cheeks puffed like the gular pouch of a male frigatebird.

"What's that you're playing?" I yelled.

"The harmonica."



"No, the song."

"Oh, 'Appassionata.'"

His music was sweet but soon lost again, a flight of chords fallen and swallowed by the freeway din.

Freeways a Dying Monster?

For all of that, the six hundred miles of freeway in the Los Angeles area work very well for some five or six hours a day. Traffic usually is snarled on only 16 percent of the system during rush hours. However, it is estimated that by 1990 the congestion will jam a third of freeway mileage.

"We have to complete construction of a few major freeways, but other than that—the plugging of gaps—the era of freeway building in Los Angeles is over," David H. Roper of the California Department of Transportation told me.

Other planners feel that rail transportation is the city's best long-term prospect. "Long-term" is certainly the proper description, since plans for mass transit seldom get far in Los Angeles. Simply put, the people of this city want nothing to come between them and their cars. Rail-transit bond issues have time and again been rejected at the polls.

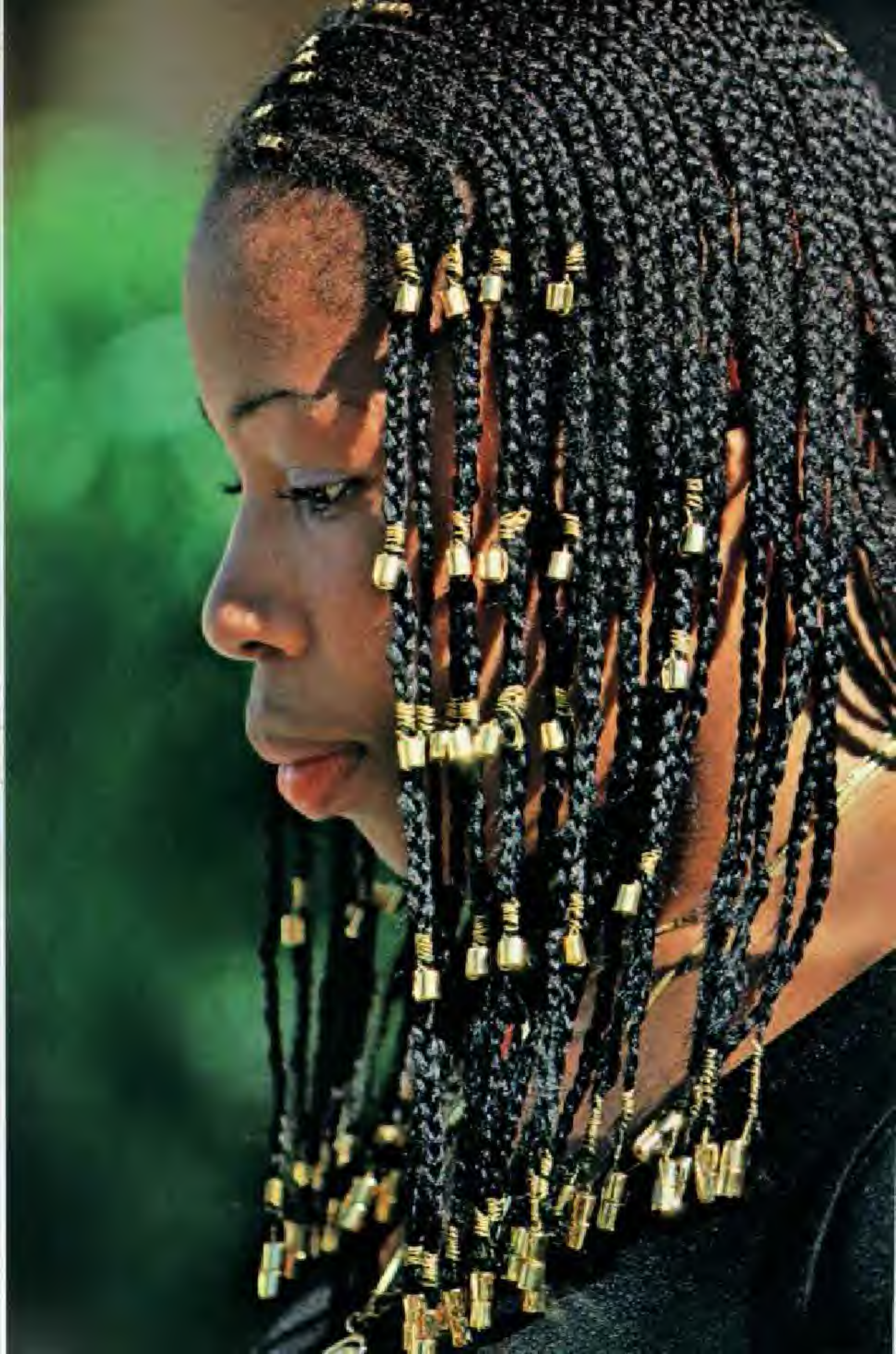
Los Angeles has a public bus system. Indeed, it is one of the largest in the country, carrying more than a million passengers a day. But most of those who ride the buses do so because they can't afford a car, or because they are too old to drive.

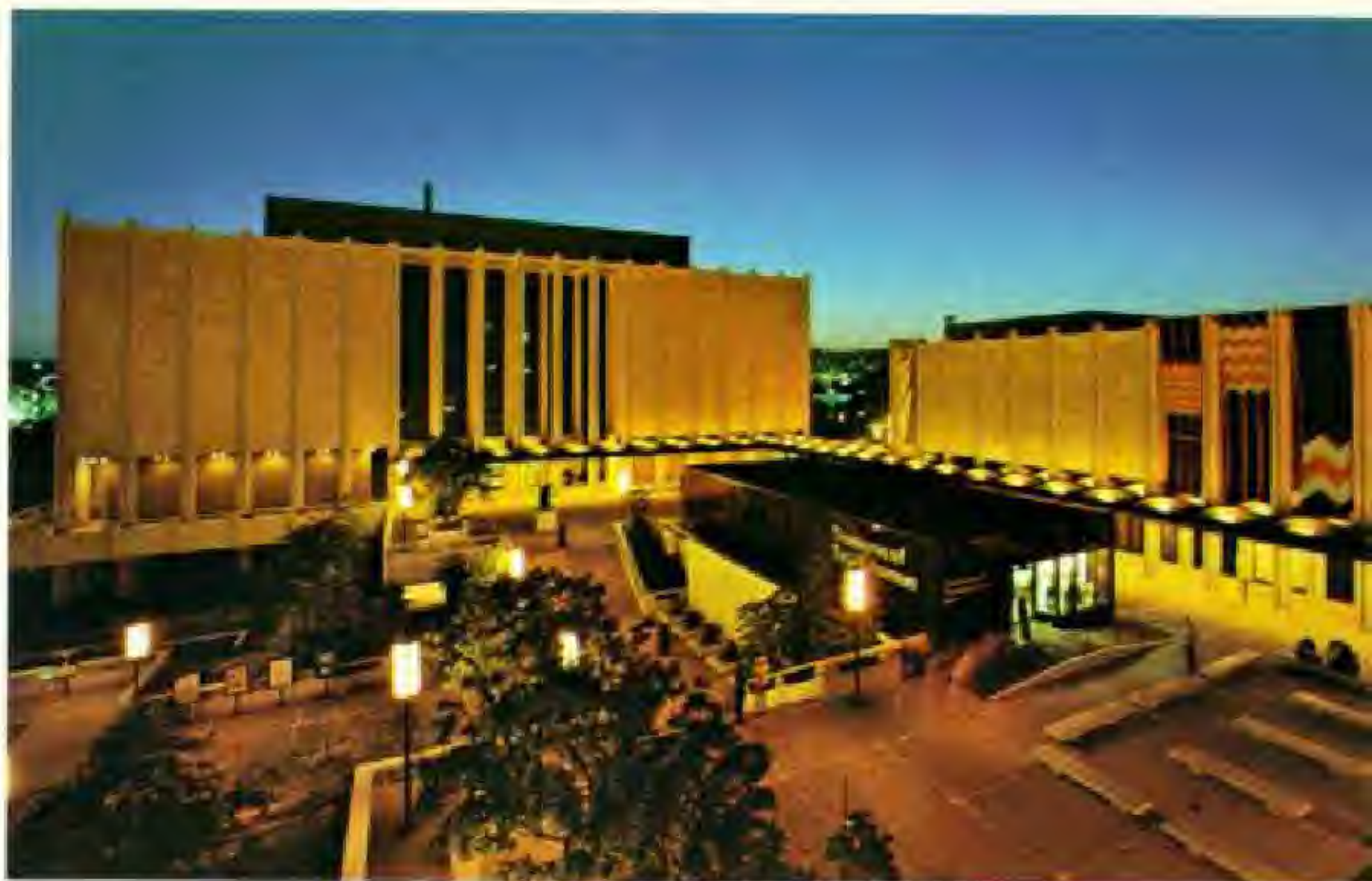
So the 5,069,198 registered private vehicles in the city and the rest of Los Angeles County continue to poison the air. It is not that restrictions are lacking. Emission-control standards are the strictest practiced in the nation. Also, when gasoline is



Cutting an imposing figure, Mayor Bradley slices a cake at the opening of a senior citizens' center in the San Fernando Valley (left). The event occurred on one of Bradley's monthly "area days," when he visits a district of his vast city to hold an open forum and meet with business people, students, and homeowner groups.

Jubilation shines on the face of Howard Jarvis on election night (above) after Proposition 13, the statewide property-tax-reduction initiative he co-sponsored, passed by a landslide and touched off a spate of similar measures throughout the nation.





Mummy mania struck the fast-happy elements of Los Angeles when the "Treasures of Tutankhamun" exhibition played to capacity crowds at the Los Angeles County Museum of Art (above). All tickets for the exhibition sold out in four days, and at more than 10,000 visitors a day a million and a quarter persons gazed at the show's 55 artifacts. Sales of replicas helped raise two million dollars for the restoration of the Cairo Museum, one purpose of the seven-city U. S. tour.

Designer and writer Jé Sand Ra was inspired by the artwork to do her hair in Egyptian braiding (facing page). At the Nailery in Westwood, women paid artist Judith Raffals Artoux as much as a hundred dollars a nail for a likeness of King Tut done in gold leaf (left).

pumped into vehicles, it is decreed by law that 95 percent of the fumes be recaptured.

Much of the problem is geographical. The city sits in a basin, a prisoner of temperature inversions and poor circulation of air. At the same time, in the presence of bright sunlight, hydrocarbons and oxides of nitrogen spewed out by cars breed ozone and smog.

"As far as photochemical pollution from automobiles is concerned, we probably have the most severe problem in the country," said Eric E. Lemke, chief deputy executive

officer for the South Coast Air Quality Management District. His agency is responsible for pollution control in Los Angeles and three other counties.

"Still, the intensities of ozone are not what they were in the 1950's," he added. "What is happening is that the smog, while not as heavy, is spreading over a wider area."

Like most of the bad things about Los Angeles, the pollution could be much worse. To cope with its problems in the jungle of big-city management, Los Angeles has hacked out new paths. Thus:

- Its pollution-control program has been a model for many parts of the world.
- Los Angeles has never had a serious power shortage because of bold and original planning many years ago.
- The city has planned well for earthquakes, with building codes and advanced technologies that have thus far let its skyscrapers safely ride out the shakes and rolls.
- As a port city, it has pioneered in cleaning up harbor waters. They now teem with fish and plant life, even as traffic reaches more than 3,000 vessel arrivals a year.

Two-way Gate to the Orient

Los Angeles is a city of economic vitality. "The fact that we are the gateway for the Pacific Basin nations is one of the keys to our economic success," Mayor Tom Bradley told me. "There are tremendous opportunities for trade—brand-new markets out there that we have never tapped."

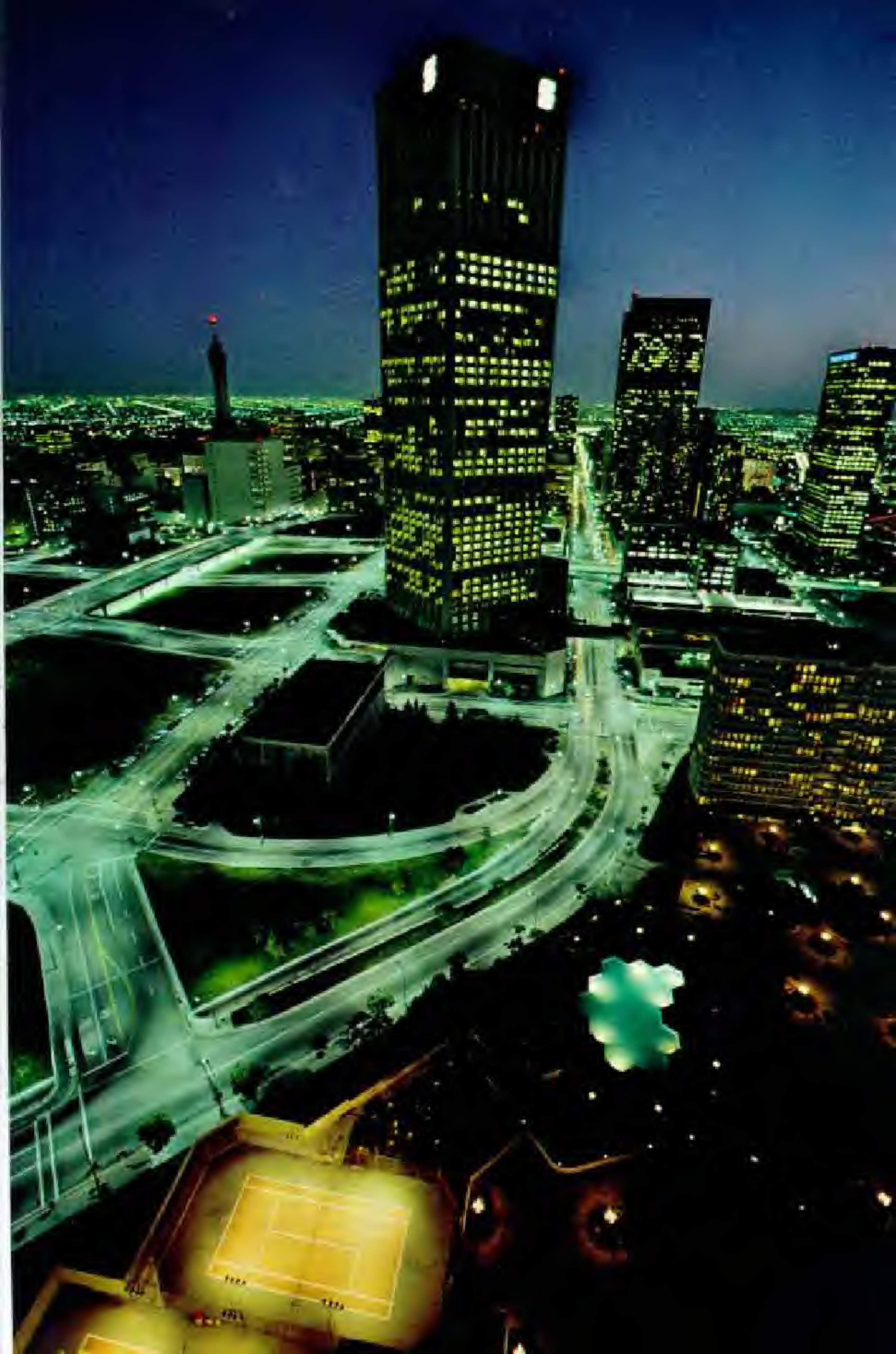
Shifts in immigration patterns have brought large numbers of Chinese, Koreans, Filipinos, and Vietnamese to Los Angeles. They have set up their own enclaves ringing downtown. This has invested the central plug of the city with a rich international flavor, but it fades in the western reaches. A good way to travel in that direction is along Sunset Boulevard, the fabled artery that extends for more than twenty miles before ending at the ocean.

Along the way, Los Angeles is revealed in all its *mélange* of character. It is Mexican at first, with billboards in Spanish and murals on buildings depicting family life and social protest (pages 38-9). Before long, the famous hills come into view.

When I first saw it, the sign read
HULLYWOOD (Continued on page 50)



A one-man war on poverty is waged by Ted Watkins, head of the Watts Labor Community Action Committee. Faulted by some for an abrasive, unconventional style, Watkins gets praise from others for the wide range of assistance programs he runs in L.A.'s biggest black area. Downtown urban renewal brought high-rises to the Bunker Hill area (facing page).





"They can't get rid of me," avows Billie Padilla, target of harassment from co-workers when she became the first female longshoreman on the West Coast. The men's own union, ironically, had opened the door. In 1975 the International Longshoremen's and Warehousemen's Union changed its contract agreement to allow

daughters as well as sons to inherit their fathers' jobs. When Billie's father died that same year, she took his place. Her day begins at 6:30 a.m. at the union hall where she waits for a job call (top). Then, before reporting, it's back to her San Pedro home to feed breakfast to her son, Nicholas, and daughter, Billieana (above). "It was hell



the first year," says Billie, who endured foul language, slashed tires, and abusive phone calls. "That's not macho. That's dumb. It didn't scare me off." She continued moving fifty-pound banana boxes and lashing cargo containers together 200 feet in the air. Billie, who is divorced, lives with her mother and a 16-year-old sister as

well as her children. "I'm no women's liber. I'm just someone who had to go out and support her family." Now two more women have joined Billie and 2,200 men on the job. The Los Angeles-Long Beach port, including the West Basin (above), forms one of the largest harbor complexes in the world.

because the top of the first O had fallen off. It sat on the side of Mount Lee and rose four stories high. It was a mess, with the broken O, the second L blackened by fire, and the D out of alignment. But it had stood for 55 years as a landmark for this magical place. Once it had been lighted by four thousand 20-watt bulbs. Now a new sign is in place, even more eye-catching, to proclaim that you are approaching the mecca of motion-picture films.

Hollywood Tinsel Out of Vogue

Glitter or not, there is a sadness about this place. There is a heavy traffic of drugs and prostitutes, and of lost teenagers drawn to a world where fame and riches ride on the spin of a record or the whirl of a camera.

Once William Faulkner and F. Scott Fitzgerald labored here—unhappily, to be sure—as scriptwriters, and actors and actresses of star rank indulged in behavior of boggling eccentricity. That era is gone. No longer is the Garden of Allah a preferred residential hotel; a bank and a parking lot now occupy the site. The motion-picture industry has fallen under the control of conglomerates, and many who are top draws at the box office shun the glamour of their profession. Some even live in Connecticut.

That isn't to say, of course, that the zany Hollywood scene is completely gone.

A man who runs an agency for movie star "look-alikes" is stopped by a policeman on Sunset Boulevard, and when he sees the officer, he exclaims: "You're my Elliot Gould."

Sydney Pollack is a man in his early 40's. He is dark, and his hair is curly, and he diets to keep trim. He is also one of the most successful producer-directors in Hollywood. They call his type a "bankable director," meaning that if he wanted to make a film of Xenophon's *The March Up Country*, the studio might question him but would probably come across with the money.

To promote a forthcoming picture on the

occult, a studio announces that it will give \$50,000 to the first person who is able to self-levitate. A man who says he is a professor of the paranormal, and who claims to have reached three stories in levitational height, announces he will train for six months to prepare himself for a shot at the prize.

Pollack's office is at Warner Bros. Studio. In the waiting room is a bookcase containing the working scripts of some of his films: *Jeremiah Johnson*, *Three Days of the Condor*, *The Way We Were*.

"Most films made are flops," he tells me. "The studios now go for the blockbuster, and so, instead of making a hundred pictures a year, they make only ten or so. And they go for the big one."

Pollack admits that some of his films actually lost millions of dollars. But others made millions more, and, in the final accounting, he is ahead. That is why he, and only a dozen or so other directors, is bankable.

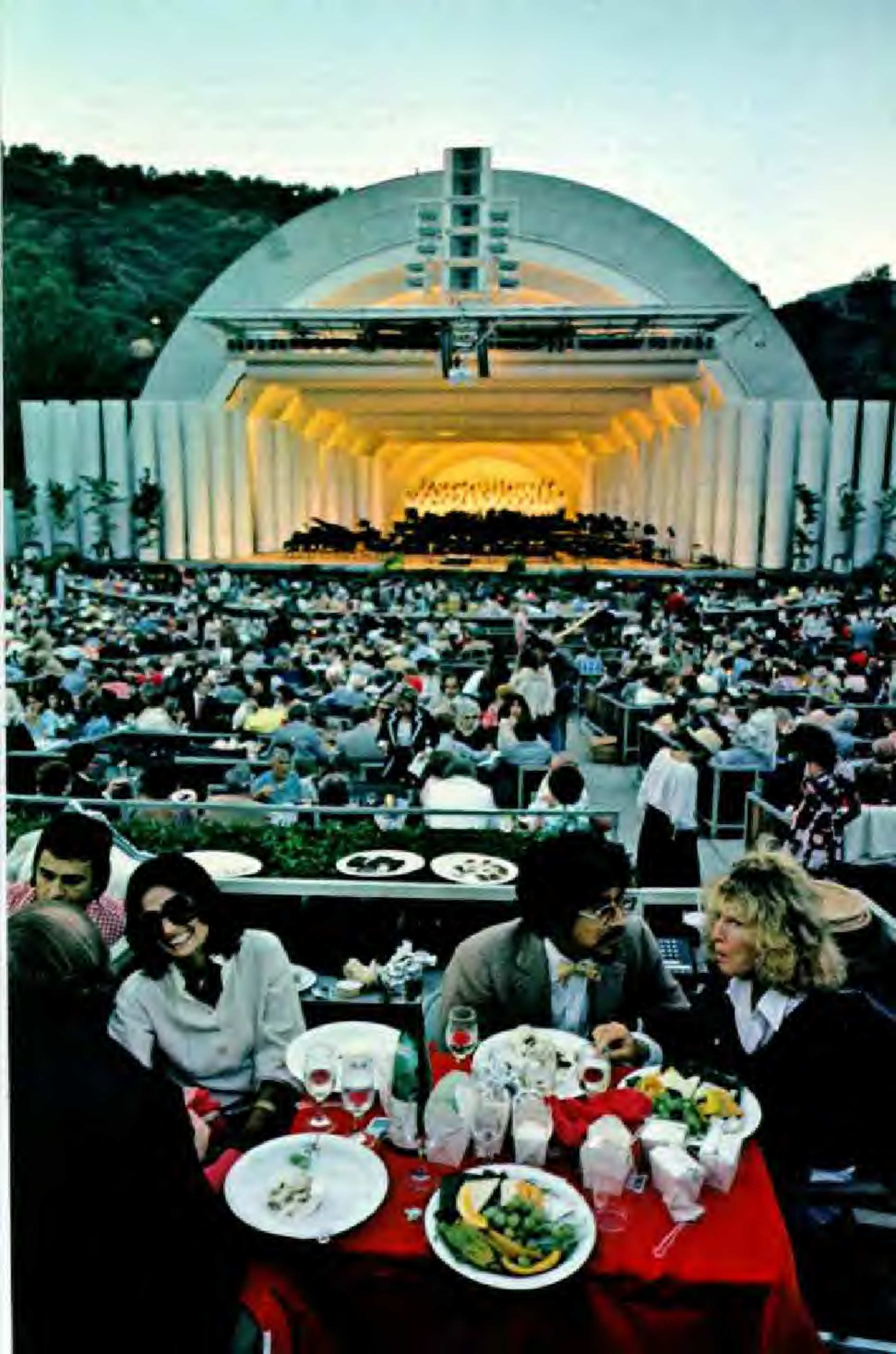
Sign on the marquee of a theater on Wilshire Boulevard: "See Klair Bybee Our Marquee Man as the Burial Detail Soldier in 'MacArthur.'"

Moviemakers are now enjoying a period of prosperity. In one week in July, for example, Paramount Pictures did \$16,611,966 worth of business, setting a new high for the industry. That same month *Star Wars* became the first film in history to take in ten million dollars in one weekend. Meanwhile, according to *Variety*, box-office figures across the nation were setting an all-time monthly high of 315 million dollars.

Films, though, are but one part of the thriving entertainment industry centered in Los Angeles. Here, along the stretch of Sunset Boulevard called the Strip, revolves a large share of the nation's recorded-music business. The pulse is fast, the money staggering, and the business has pounded this land with the amplified thump of rock.

Of those who make it as recording artists, some make it very big. But for every Elton

A jug of wine, a loaf of bread, and a chorus singing in the background create a kind of paradise in the Hollywood Bowl, particularly on opening night, when, for picnickers, part of the scene is to be seen. Later the National Symphony's Mstislav Rostropovich led the Los Angeles Philharmonic through Brahms and Prokofiev.



John, there are a thousand unknowns who walk the Strip carrying their guitars and their hopes for the break that is never to come. So they find work as parking attendants, and eventually they go home.

Jim Rissmiller is a highly successful promoter of rock concerts. Among the groups he presented last year were the Rolling Stones, Electric Light Orchestra, and Boston. "We sold out the Rolling Stones concert—55,000 seats—in two hours," he said. In 1978 his firm grossed about 15 million.

"There's no limit to this business," he said. "More groups are coming along—better groups. Also, whereas in 1964 the ages of those who attended the concerts ranged from 13 to 18, it's now like 13 to 60."

Although not yet 40, Rissmiller's success as a promoter has allowed him the luxury of

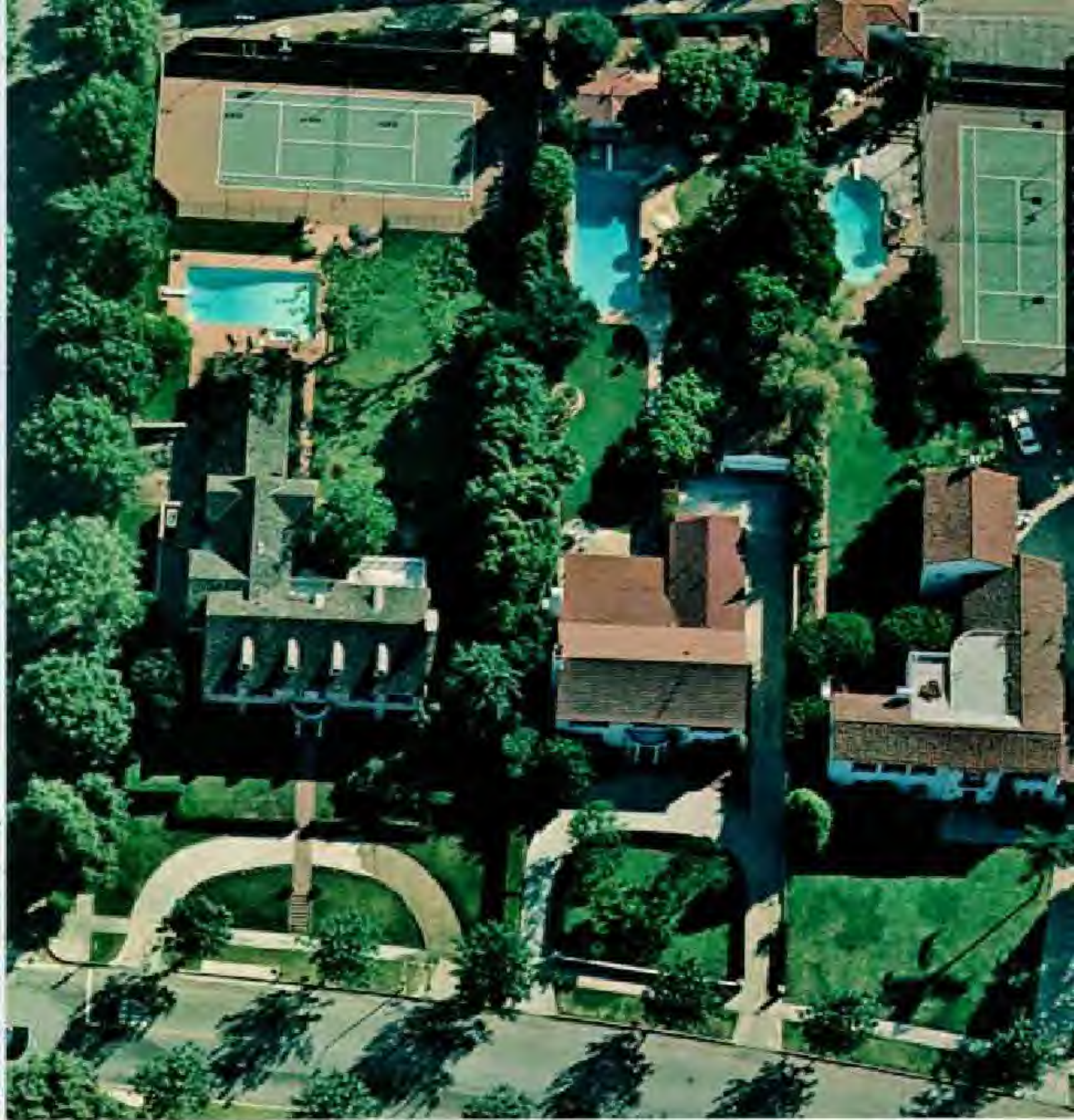
part ownership of the Philadelphia Fury, a team in the North American Soccer League. "I'm from the Philadelphia area, and that's why I wanted to get into that franchise," he said. "Hometown boy makes good—that kind of thing."

Los Angeles gives us our films, much of our music, and most of the mind-numbing programming of network television. Quiz shows, situation comedies, police dramas—almost all are filmed here. For the many weeks I was in Los Angeles, a day seldom passed without the whack of clapboard going off in my ears, followed by a director's exhortation to please get out of camera range. As far as I can tell, I left the city having made unscheduled appearances in two episodes of "Police Woman," one "Fantasy Island," and a commercial for a flea collar.



Smacking a clean single on the head of coach Monty Basgall, Los Angeles catcher Steve Yeager clowns before a game at Dodger Stadium. The attention was more self-directed for these athletes (above), preening backstage before the Mr. U.S.A. contest at Santa Monica Civic Auditorium.





Backstrokes and backhands are just a short stroll away for Beverly Hills residents with pools and tennis courts in their backyards. The ethnic makeup of this moneyed

On Cahuenga Boulevard there is a building in which once was housed the Small World Restaurant. It is a dark, cavernous place, and for three days of the week it overflows with fat ladies in leotards and others who appear to audition for "The Gong Show." For the most part, these are people with no show-business talent, but then that is what "The Gong Show" is all about.

"You've got to be very good or very bad to get on this show," one of the production

assistants whispered to me. "What we like best are the 350-pound go-go dancers."

Following performances by a bad impressionist and a woman vocalist in clown makeup, there appeared on the stage a short, thin, rumpled man who said he was 24 years old, of Lebanese descent. He was, he announced, a dancer.

"You got music here?" he asked. When told he had to supply his own music, he said, "No music, huh? I'm a dancer and it's hard



oasis, entirely surrounded by the city of Los Angeles, is changing. As real estate values soar, many Arabs and Iranians are buying up property for investment purposes.

to dance without music, you know." But he danced, and after he finished, I stood with him on the sidewalk outside the studio. "I left my home in Brooklyn and drove to Baltimore, where I was arrested for not having registration for my car," he said. "I had \$65, and \$40 of that went for the fine."

His eyes were red, and a stubble of beard hung on his chin like a frayed feed bag. "I hitchhiked here from Baltimore," he said. "Got here two days ago and stayed the first

night in a coffee shop. Last night I slept in a Baptist mission. But I'm going to stay out here until I get a job as a dancer."

Sunset Boulevard leads west out of Hollywood under the shadows of billboards advertising records and package weekends in Las Vegas. They are soon left behind, however, for the great street penetrates into Beverly Hills (above), a moneyed settlement where automobile dealerships are called "carriage houses," and where Japanese



gardeners toil amid horticultural splendor. The hoary joke here is that even the police department has an unlisted number.

Having successfully resisted a sweeping, tax-base-broadening annexation grab by Los Angeles, Beverly Hills remains an incorporated city wholly within the boundaries of the metropolis. There are many Mercedes and Rolls on the streets here, and nowhere is the panache of the place reflected more strongly than on Rodeo Drive.

Rodeo (pronounced, please, Ro-DAY-oh) Drive has been called the most elegant shopping place in the world. Prices are such that in one men's clothing shop, the cheapest item is a hundred-dollar necktie. Rodeo is a place to see and be seen, to try to give a name to the familiar face (Myrna Loy?) being welcomed by the doorman at the house of Gucci, to greet friends with elaborate

hugs, and to marvel at the works of plastic surgeons.

Mike Silverman sells houses in Beverly Hills. A million dollars is not an unusual price for one of his properties. He sells to many movie personalities, and when they are divorced, he sells the houses again. The failure of marriage is an important factor in his business.

His "For Sale" signs are frequently seen on the lawns of mansions secluded behind iron gates. Who buys such places now?

Something Money Can't Buy: Taste

"There has been a large injection of Arab and Iranian money into Beverly Hills," he said. "Two million dollars for a house here may seem outrageous to you, but to a wealthy Iranian it's a good investment."

It was a Saudi Arabian who bought the



Silver threads among the gold-braided ranks of graduates at the University of California, Los Angeles show there's no age limit to education in an area that counts seventy colleges and universities. Frances Hostetter, 71, sings "Hail to the Hills of Westwood" with the spirit that earned her honor as a chancellor's marshal. Mrs. Hostetter plans to continue her practice of never missing a UCLA home football or basketball game while pursuing a master's degree in English literature.

father made a hurried trip from Saudi Arabia. He invited the neighbors in for a party. Others came, too, and at the end of the evening, after the caviar, lobster, and shish kebab had been devoured, the owner of the lime-colored house on Sunset Boulevard went to sleep in the \$60,000 master bedroom, at peace with himself for having calmed the storm in Beverly Hills.

Departing Beverly Hills, Sunset Boulevard winds north before dropping down to rim the 411-acre campus of the University of California, Los Angeles. It is an institution of high academic ranking—12th or 13th in the nation. Of its 31,000 students about two-thirds are undergraduates, and virtually all graduated from high school in the top 12.5 percent of their classes. With 24 attached institutes and research centers, UCLA can claim many advances in many fields. Medicine, for example.

Dr. Paul I. Terasaki, a professor in the Department of Surgery at the university's School of Medicine, has been working for 15 years with white blood cells, seeking to type human tissue. He has succeeded, and the result has been of great importance to the procedure of transplanting a kidney.

"There are thousands of combinations in tissue typing, and it is difficult to match a recipient with a donor because of the odds," Dr. Terasaki said. "But now at least we know what we're looking for." Tissue typing also helps to determine the susceptibility of some people to disease, and can be useful in paternity cases and criminal investigations.

For all of the distinguished scholars and researchers attracted to the UCLA campus, for all of the twenty libraries with four million volumes, for all of its academic

house with the statues, the one sitting on a hill beside Sunset Boulevard. It is a big place, with 38 rooms, and it cost the member of the royal family 2.4 million dollars. He purchased it for his 23-year-old son, then a student in Los Angeles. The young man re-decorated the mansion, and when he was finished, it was something to behold.

The exterior was painted lime green. Skin-tone colors covered the statues, and the Romanesque urns were filled with plastic flowers. Inside, some of the more inspired decorative touches included several three-dimensional photographs of women unclothed except for veils over their faces, and a portrait of the San Francisco Bay Bridge on black velvet.

For a while the curious clogged the sidewalk in front of the house. Complaints poured into City Hall, and the student's



luster—for all of that, the university is perhaps best known outside California for its sports programs, especially basketball.

As a city addicted to sports, both collegiate and professional, Los Angeles likes winners, and winners it has. On the football field it's the Rams, and on the basketball court, the Lakers. But most of all it's the Dodgers on the baseball diamond. And now the city is preparing to host the 1984 Summer Olympic Games.

Surfers, Artists, and Muscle Men

Sunset Boulevard ends less than ten miles from the UCLA campus, for there the wide Pacific rolls against the edge of the city. Then Los Angeles becomes all beaches and golden girls, surfers and muscle men with a rudeness of biceps. Malibu is there, and to the southeast of that Marina del Rey, flagship of the singles scene. Both are in unincorporated sections of the county. North of Marina del Rey, and within the city proper, sits colorful Venice, longtime home of poets and artists.

All of that is at the other end of the spectrum, not many miles away, but light-years apart from the barrio of East Los Angeles. And from Watts.

At the present time Watts, the scene of violent racial riots in 1965, is at ease. Government-funded programs to improve conditions for those who live there have brought new housing and an outpouring of social services. The guiding force behind much of that is a man with a shaven head and diamond rings shaped like horseshoes on his fingers. His name is Ted Watkins (page 46).

As head of the Watts Labor Community Action Committee (WLCAC), Watkins has battled government bureaucracy on all levels to get funds to feed the elderly, to develop job-training programs for the young, to provide housing and bus transportation. Under his direction, the WLCAC has come to own the only service station in Watts, a shopping center with a Ferris wheel on the parking lot, and a cafeteria.

"We have programs to serve the people of Watts from cradle to grave," Watkins told me as we drove along 103rd Street, known as "Charcoal Alley" during the fiery riots. "Our houses are put out to rent, and after the occupant rents for twenty years, the house is his, free and clear."

There are a lot of things about Watts that Ted Watkins does not like. He does not like the city-sponsored housing developments because he feels they were not planned with the best interests of the people in mind. He does not like the sight of so many women and children on the streets of the developments because, to him, it indicates that most are on welfare. (Eligibility can be lost with the presence of a male in the house.)

And he doesn't like the charred doors of some houses in Watts—burned as a result of explosions during the manufacture of the drug PCP, or "angel dust."

The End for Carefree Growth

It is somewhat symbolic of Los Angeles that the landmark of Watts is a group of towers made of broken bottles, seashells, shards of tile and china, and assorted city flotsam. It took Simon Rodia, an Italian immigrant, 33 years to construct the towers, two of which rise nearly a hundred feet. They were his personal statement of tribute to the land that took him in.

Symbolic, yes, because towers of junk could rise in Los Angeles, and who was to care? Hamburger stands could be constructed in the shape of hamburgers, and a firm could conduct business in the replica of a medieval castle complete with moat, and who was to care?

Carefree it drifted, as long as there was room to drift. But it ran up against the ocean and the mountains, and some of its streets became filled with people who spoke only foreign languages, mostly Spanish, and freeway effluvia sullied that good sunlight.

It was time for the City of the Angels to anchor. It hasn't done that yet, but the chain is going down. □

The City of the Angels has more than its share of earthly beauties, some with the means to shop on exclusive Rodeo Drive. A place too caught up in where it's going to worry about what it is, L.A. combines attractiveness and tackiness, a restless potpourri of cultures, and an endless array of pursuits—composing a city that eludes definition.

MAN IN THE AMAZON:

Stone Age Present Meets Stone Age Past

ARTICLE AND PHOTOGRAPHS BY
W. JESCO VON PUTTKAMER



Apprentice archeologists, the Wasúsu Indians of Brazil help excavate one of the oldest sites used by humans in South America—Abrigo do Sol, or Shelter of the Sun. From the dig's lower strata, crude stone tools attest the presence of man on the edge of the Amazon Basin at least 9,000 years ago. A potsherd decorated with a deer head (above) was found nearby.

IN LUSH JUNGLE on the southern rim of Amazonia, we are digging in the floor of a deep shelter in a rock escarpment. Swarms of stingless sweat bees pester us constantly. Powdery dust composed of millennia-old vampire bat guano makes our eyes and noses run as if we have bad colds. We are not comfortable.

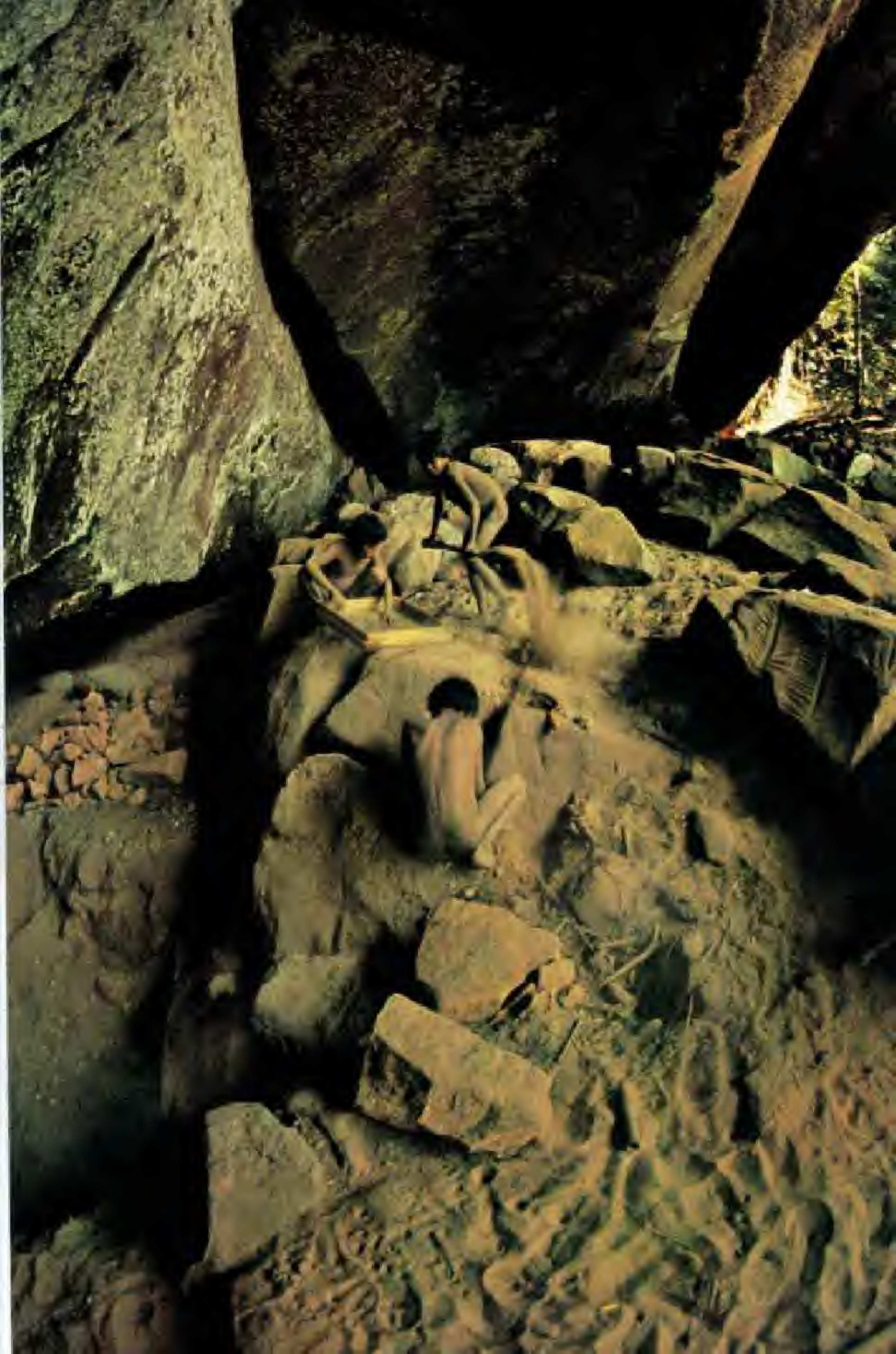
So why do we dig in this place? Because about 9,000 years ago—possibly 12,000—some of Brazil's earliest inhabitants used it extensively. By digging, we may uncover something to tell us who these Paleo-Indians were and what was their eventual fate. I have named the site Abrigo do Sol, or Shelter of the Sun, because I suspect from their rock carvings that these shadowy people worshiped the sun at this place.

On the dig, the first ever conducted under scientific auspices in Brazil's Mato Grosso State, there are only a handful of *civilizados*, and only one of them is a scientist—Eurico Miller of the Archeological Museum of the State of Rio Grande do Sul (page 63). Grants from the National Geographic Society and the Smithsonian Institution support his work.

As for myself, a photographer and diarist, I have often accompanied the professional *sertanistas* of FUNAI—the government's National Foundation for the Indian—on expeditions into unexplored country. The Portuguese word “sertanista” literally means a person “wise in jungle ways,” but has come to denote an expert at contacting hostile Indians of Brazil.

The other workers at the site are Indians, among the most primitive in all Brazil. They are predominantly hunters and gatherers whose way of life, at least until civilized people entered this jungle only a few years ago, differed little from that of the tribes living in the region centuries ago. As a matter of fact, they may be the actual descendants of the aborigines who used the shelter, although they say they are not, and Eurico says there is no way of knowing. They tell us the people of the shelter were all killed long, long ago, but they are vague as to how and by whom.

These Indians, whom we have taught to collect such clues from the shelter floor as bits of pottery and stone implements, are the Wasúsus, today numbering about 55 souls. A pathetic remnant of a once populous tribe,



the tiny group belongs to a loose confederation of warriors called the Nambicuaras, who around the turn of the century successfully defended their habitat on the savanna of the Mato Grosso Plateau against all intruders.

Arrows Greeted Early Explorers

In 1907 Nambicuaras gained the attention of the outside world when they attacked an exploring party led by Col. Cândido Mariano da Silva Rondon, founder of the service that was to become FUNAI. Rondon, himself partly Indian, was hit by a long Nambicuara arrow, but a leather belt he was wearing deflected it.

The Nambicuaras are reasonably peaceful today, although I think that if they were as numerous as they once were, and if their villages were not so widely scattered, they would still be making life miserable for the army of road builders, loggers, ranchers, and farmers seeking to exploit Amazonia.

I first met the Wasúsus some nine years ago. I was exploring in Amazonia with the FUNAI party that made the first peaceful contact with the dangerously unpredictable Cintas Largas Indians* who inhabited Mato

*Mr. von Puttkamer described the Cintas Largas in the September 1971 NATIONAL GEOGRAPHIC. Loren McIntyre explored "Brazil's Wild Frontier" in the November 1977 issue. For more on Brazil's Indians, consult the *National Geographic Index, 1947-1976*.



Grosso and nearby Rondônia Territory.

Only recently "pacified" by FUNAI and dedicated missionaries, the Wasúsus were living not on the high, open plateau, as do most of the Nambicuaras, but at its base in the dense jungle along the upper Galera River (map, page 67). I know of only one other Nambicuara group that prefers the forest to the cool and windy savanna, but there may be more. Just when we *civilizados* think we have found the last unknown tribe in the vast jungle of Brazil, someone poking into the wilderness will be greeted by a shower of arrows fired from some place hitherto believed to be uninhabited.

From our very first meeting the Wasúsus

and I became friends, and I returned several times to visit them. On one of these visits I found the group in despair. From two of my special Indian friends, Vaiôco and his wife, whom we called Barbara, I learned why.

Threat to Wasúsu Homeland

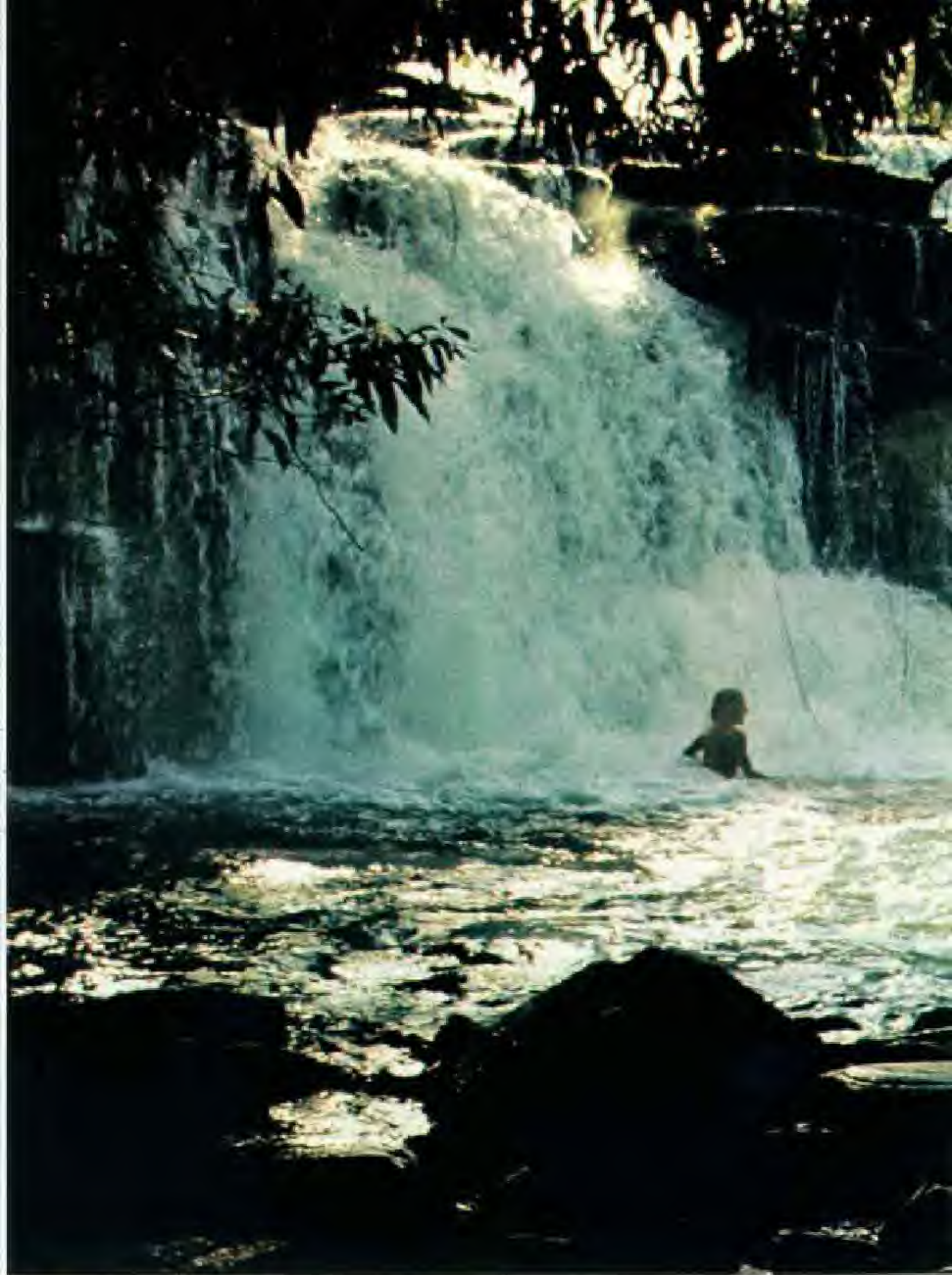
FUNAI, then under different leadership, had told the Wasúsus they were to be moved from their home in the jungle to a new Nambicuara reservation on the savanna about a day's journey away.

Finally, the dreaded resettlement took place. The reason for moving the Indians was the usual one: The government had turned their

(Continued on page 68)



Back in the jungle after the government aborted its effort to resettle them on nearby savanna, Wasúsu men celebrate with traditional flutes (left). Beside a boundary marker, a tribe member shows Brazilian archeologist Eurico Miller territory returned to the Indians.



Bound for the Amazon's mighty and muddy surge some 800 miles to the north, scores of cascading rivers offer pristine bathing for the Wasúsus and other Nambicuará



Indians. Throughout the sprawling Guaporé watershed, on Mato Grosso State's open plateau, live most of the dozen or so groups that make up Brazil's Nambicuara tribe.





Emblem of an Amazon queen? Or just a fertility symbol like those found in Stone Age caves worldwide? While scientists assign the latter interpretation to this triangular carving (left) and hundreds of others found in Abrigo do Sol and nearby sites, the author—an admitted romantic—tends to believe the Wasúsu explanation: They are tokens of a long-vanished tribe of warrior women. This story adds credence, he believes, to reports of such women by Spanish explorer Francisco de Orellana, who sailed down the Amazon to its mouth in the early 1540's.

According to the young Wasúsu mother



(facing page) who led the author to the secret rock-shelter and volunteered tribal lore, the numerous sun symbols (above), for which the main excavation was named, indicate that the people who used the shelter worshiped the sun.

Project scientist Miller regards such views with skepticism. But regardless of their significance, the carvings establish that Indians occupied this region along the Galera River—a tributary of the Guaporé in northern Mato Grosso (map)—long before the arrival of whites. Though hardly surprising, this gave added weight to efforts by FUNAI, Brazil's National Foundation for the Indian, to return the Wasúsus to their ancestral lands.

(Continued from page 63) land over to huge private enterprises that would cut the valuable timber, burn what vegetation was of no value to them, and turn the denuded land into farms and ranches. Already the new owners were streaming in over recently cut roads, bringing truckloads of humped zebu cattle and machinery for sawmills and power plants. Airplanes for sowing range-grass seed were landing on hastily built airstrips.

Wasúsus Turn to Author for Help

Unfortunately for the Wasúsus, part of whose subsistence comes from crops they grow in jungle clearings, the soil of the savanna is poor, game is scarce and becoming ever scarcer as *civilizados* move in with their efficient firearms, and winter is colder there

than in the forest. True, there are fewer insect pests, but the jungle Indians, used to bites and stings, do not greatly mind bugs.

In a desperate search for friends—any friends—who might help them end their exile on the savanna, the Wasúsus turned to Borbula, or “man with the great moon face,” which is the name by which I am known to many of Amazonia’s tribes.

“If you will help us,” said Barbara, a young Wasusu woman of keen intelligence, “I will show you secret things we would never show to any other *civilizado*. These things will prove to the big people of the government that our land in the jungle has belonged to the Indians since long before any *civilizados* came—and that it is our home now. If the big people know this, then they will let us move back.”



For many days I followed Barbara and Vaiôco over dim forest trails to Abrigo do Sol and other rock-shelters where some unknown people had carved mysterious drawings into the walls and left sherds of decorated pottery in the ashes of ancient fires. Barbara had kept her part of the bargain. Now I had to keep mine.

First I persuaded two friends, Professors Mari Baiocchi and Altair Sales Barbosa of the Catholic University of Goiás, to visit the shelters to see if an archeological dig was warranted. They came, made test trenches, and recommended a thorough study.

With this assurance I asked the National Geographic Society for support. The Society agreed to help and also asked the Smithsonian Institution to join in furthering the project. Thanks largely to the efforts of

FUNAI's veteran sertanista, Fritz Tolksdorf, I enlisted the cooperation of the Brazilian Government.

Dig Helps to Prove Wasûsus' Claim

And so, seven years after the Wasûsus had shown me the places they had kept hidden for so long, we—and the Wasûsus—began laboring with picks, shovels, and sieves in the floor of Abrigo do Sol, coughing and sneezing in clouds of acrid dust.

But even before digging started, our project had produced heartwarming results: The Wasûsus would not be forced to remain on the savanna after all!

FUNAI had reported to the Brazilian Ministry of Interior that our preliminary work proved that Indians had occupied the valley of the Galera since long before the first



From Abrigo's pay dirt, Wasûsu girls (left) separate fragments of pottery and stone with a sieve like those used by diamond prospectors in the region. Able recruits in the service of science, the Indians exhibited irrepressible enthusiasm for turning up new finds, such as a pipe head (above) dug from the ashes of an ancient campsite. For their efforts they were rewarded with food and cooking utensils by the *civilizados*.



Stairway into the dim past of early man, Abrigo's carefully stepped excavation (right) is abruptly halted seven meters down by boulders thought to have dropped thousands of years ago from the overhang (above), seen here before work began in 1975. Since tests show evidence of man beneath the slabs, Eurico Miller hopes to remove the impediments with heavy equipment and to probe even deeper.

Europeans landed in Brazil. And, importantly, our work in the region also showed conclusively that the Wasúsus inhabit the area today. The government moved swiftly under a law holding that any land on which Indians are living cannot be taken away from them: It rescinded the land titles that it had given to the big agricultural and industrial combines already at work in the valley, and made the territory the property of the Wasúsu people forever.

We might have had a celebration, but the Wasúsus had more important things to do. Donning war paint, the warriors went off to where a party of lumberjacks was felling huge mahogany trees on land that is now irrevocably Indian. The poor loggers, terrified by the unexpected sight of Indians advancing upon them with six-foot-long arrows notched to powerful bows, wasted no time leaving. Their terror was ludicrous. They ran through the forest like scattered partridges, shouting for help.

One cannot really blame the outsiders for

fearing Indians. Over the years the fierce warriors of the forest have taken a heavy toll of gold and diamond prospectors, lumbermen, and road builders.

On one occasion an assistant and I spent a night camped in the jungle beyond the farthest point reached by road crews. The workers, who had just found bare footprints in ground they had cleared, watched wide-eyed as we passed their camp and disappeared into the forest. We spent an uneventful night and were greeted as heroes when we returned unharmed to the roadhead in the morning.

Shelter Yields Bones, Gold Ornament

The digging in and around Abrigo goes on. It is not exciting work, although once we found a gold ornament and another time the crumbling bones of a small child.

The ornament appears to be a pendant. Eurico Miller thinks it may be part of a necklace, but I have seen Brazilian Indians wearing similar bangles in their earlobes. There





Clues by the thousands, but no solution



TROPICAL EROSION awaits and spares nothing," warned Eurico Miller before returning to Abrigo with National Geographic Society support in July 1977. What he found confirmed his worst fears: Downpours during the preceding rainy season had washed through the strata of untold centuries, creating eerie formations of earth (right), each capped by a small fragment of stone or ceramic material. Amid these spires, just outside the protection of the rocky overhang, many sherds may have fallen to levels dated by carbon-14 tests to earlier times. Matching dates with artifacts thus became a near-impossible task.

Several hundred pounds of pottery fragments were found in Abrigo's upper strata, as well as on the surface of 13 still unexcavated sites in the surrounding region. Numbering 8,960, the fragments display a remarkable variety, from incised geometric patterns (top, left)—some bearing the sun symbol (second from top)—to appliquéd designs (third from top). The origins, as well as the fate, of the primitive artisans who fashioned these pieces remain a mystery. The Wasúsus and their Nambiquara neighbors—among Brazil's most primitive Indians—make no pottery.

In the middle strata of the dig, the remains of a preceramic Stone Age culture were found, and pottery fragments entirely disappeared. Here on the edge of the Amazon Basin—where no evidence of Paleo-Indians had previously been found—were several millennia's accumulation of crudely chipped flakes (bottom), cores, and other assorted grinding and scraping tools. A number of carbon-14 test results indicate that the deepest of these artifacts might be 17,000 years old.



is no mystery as to the origin of the ornament, although we have no reliable clue as to its age. Gold deposits, no longer worked, can be found not far away. Our pendant appears to have been made from a nugget hammered flat with a stone, then cut to roughly rectangular shape and pierced with a small hole.

As to the bones, they could not have been buried long ago, for the jungle soil is strongly acidic, and organic matter, even large bones and teeth, deteriorates quickly. We surmise that the youngster was someone special and thus rated burial in the sacred shelter. These are the only bones we have discovered in Abrigo do Sol.

Each evening we come home to a jungle clearing several miles from the dig, where we have set up a camp of tents, brush shelters, and a mobile home. The presence of such a vehicle in the heart of the jungle is not as remarkable as it would have been only a few years ago. Hundreds of miles of highways and logging roads now cut through the wilderness. Some are even paved, but most are merely raw cuts in the forest, deeply rutted by heavy trucks and occasionally all but impassable for standard automobiles.

Vampire Bats a Jungle Reality

Our camp attracts the biting flies of the jungle, the voracious *borrachudos*, by the millions. It attracts other, more dangerous pests as well. More than once, asleep in my hammock, I have been awakened by stealthy movement on my toes and have found a vampire bat walking about looking for an opening in my blanket so it could make a meal of my blood.

We keep careful watch for rattlesnakes. Entering caves, we leave room for frightened tapirs to dash out past us, for these big animals like to hide in daytime.

One night Eurico was driving to camp when something leaped from the jungle onto the hood of his jeep, leaving long scratches in the paint. The animal disappeared into the underbrush on the other side of the trail. Eurico thought perhaps it was a deer. But the next morning, in the mud beside the track, we found the pugmarks of a large jaguar. On another occasion Eurico was forced to shoot one when it insisted upon invading the camp night after night.

I've seen enough jaguars to become convinced that individual cats will sometimes hunt humans for food, particularly small Indian children. While Brazil now has game laws protecting its jungle wildlife, one may dispose of a jaguar or panther that poses an obvious threat.

The same is true for anacondas, the world's longest snakes, which are abundant in this area of Amazonia. A big anaconda can swallow a fair-size prey, and the Indians claim they know of cases in which the snakes have eaten people. I am inclined to doubt this, but I keep well clear of anacondas just the same.

Ants in Pants Prove Disastrous

Poor Eurico! He is the one to whom all possible unpleasant things happen. When he hung up a freshly washed pair of his shorts to dry, leaf-cutting ants chopped them to pieces, leaving only a little pile of buttons on the ground beneath the tree.

When we stayed overnight at a ranch that boasted a fine outhouse with a mahogany seat, Eurico was the one who nearly fell through; termites had riddled the seat.

But sometimes his luck changed. A hen he brought from home as a future meal took to laying eggs in his jeep. In return for tasty breakfasts, the chicken escaped the pot.

We both suffered from the usual jungle complaints, of course: dysentery, insect bites, and malaria, of which I have had almost a hundred attacks during my years in the forest. The Indians are virtually immune to these things, but diseases of civilization, such as measles, influenza, and tuberculosis, have wiped out entire tribes.

With the coming of the roads, Amazonia has attracted entrepreneurs who have established gasoline stations, hotels, restaurants, and stores. In addition, bus service and microwave telephone help us keep in touch with the outside world.

Usually we can obtain the sort of food we would eat at home, although the Indians, who are permitted to hunt as they please, often give us such things as red deer venison, armadillo—to be cooked in the shell—tapir steak, and the tasty tails of caimans, South American crocodiles.

Once a little Indian boy handed me a small roasted animal that smelled most



Tempest of sand and wind catches Eurico Miller during one of the cold spells delivered to Brazil's Mato Grosso Plateau each dry season by winter winds from the south. In its aftermath columns of fragile soil stand secured by bits of stone and ceramic. Such erosion may account for the large number of surface relics found near Abrigo.

delicious. Hungry. I ate with gusto. Only then did the boy casually mention that the delicacy was a vampire bat.

Besides the entrepreneurs with legal business in the wilderness, there are, as on any frontier, men whose occupations do not stand close scrutiny. Nearly every morning, while it is still dark, we are awakened by the sound of a low-flying airplane rushing overhead without lights. This is a smuggler, bringing whiskey, cigarettes, and other contraband from Bolivia or Paraguay, and landing at some secret airstrip deep in the Brazilian jungle.

What few police can be spared to enforce the laws in Amazonia are kept busy chasing

wild-animal poachers, people with illegal guns, and even murderers, for the forest is a good place to drop out of sight. The police do their best but catch few malefactors.

Eurico Miller has worked for three seasons in Abrigo and explored 13 other nearby sites. As I write, digging has stopped at Abrigo and may not be resumed for some time because we have reached a level where great boulders, fallen from the shelter roof long ago, block our shovels. One day we hope to break up the boulders with mechanical drills and dig yet deeper, in the hope that we will reach levels containing relics even older than those already unearthed.

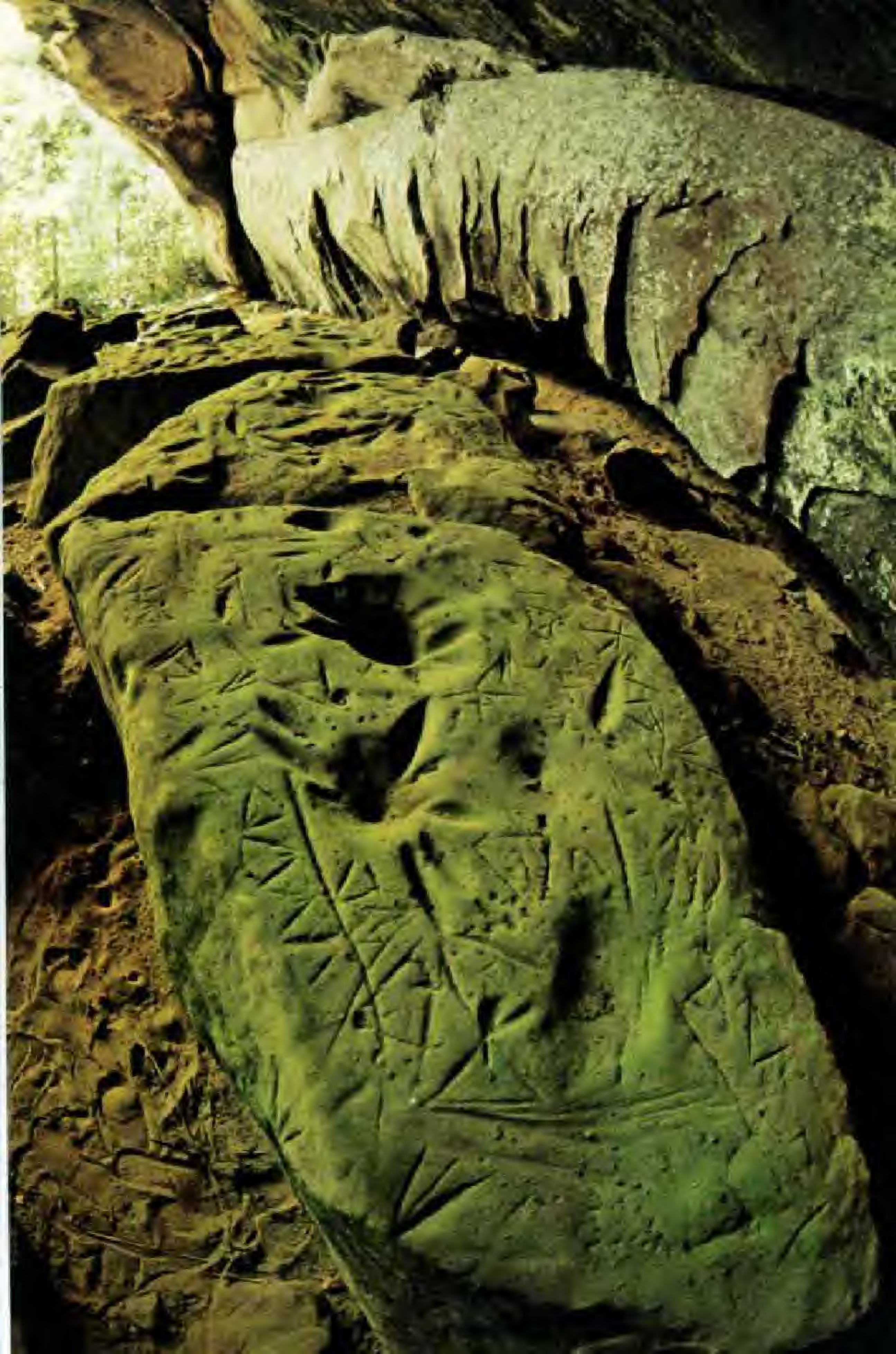
Until every possible bit of evidence has



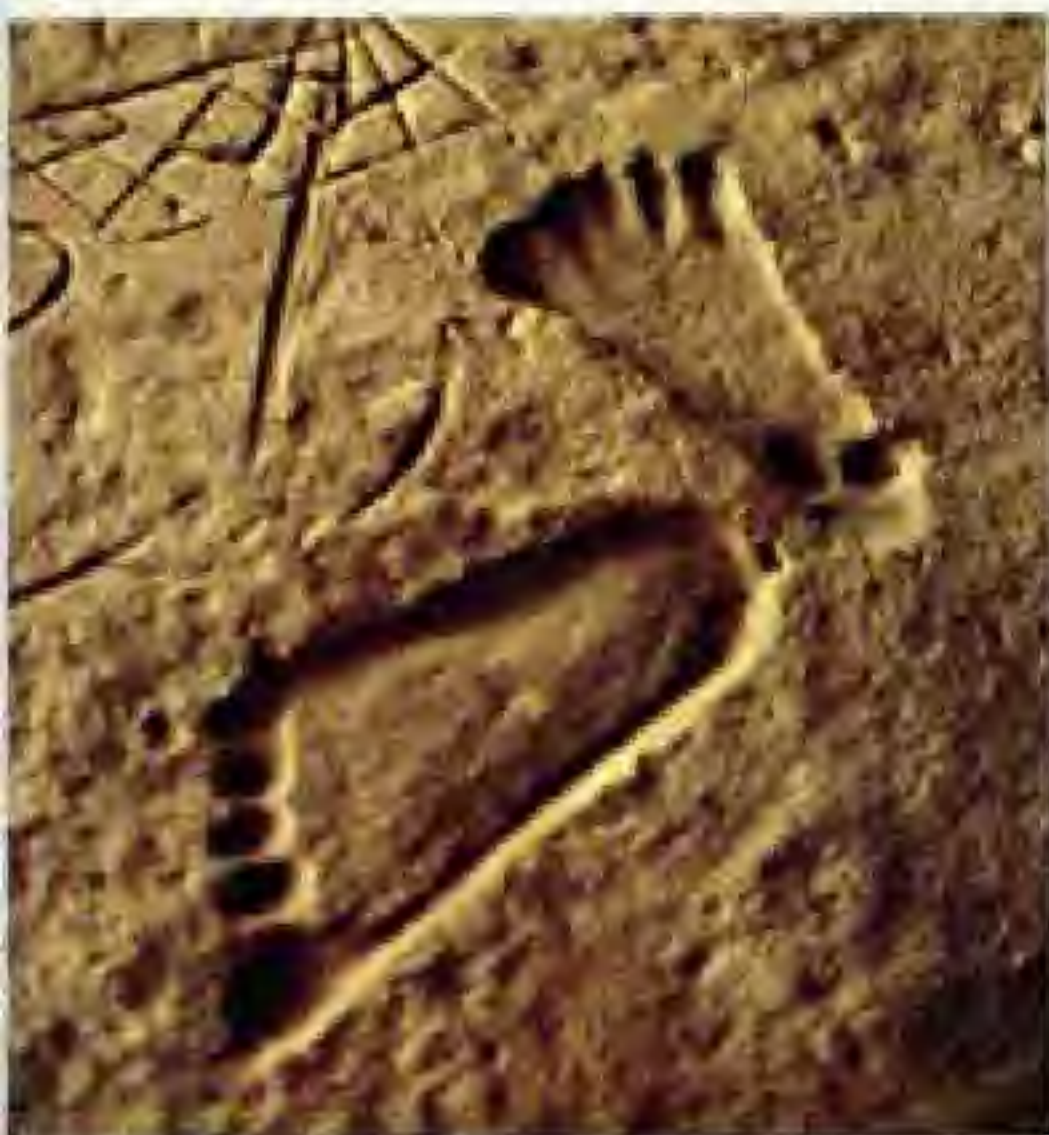
A new horizon of Paleo-Indian life in Brazil's interior is indicated by the rich lode of rock carvings at Abrigo do Sol. The secrets of the site's petroglyphs may one day be deciphered, but for the present no one knows if they are meaningless graffiti or true symbology.

Dug from deep strata in the floor of the shelter were several roughly decorated rocks thought to have sloughed off the surface thousands of years ago. Eurico Miller carefully cleans one (below) decorated with markings similar to many that have been found amid the remains of primitive cultures throughout the world. Adorned with the ubiquitous female symbol, another (right) bears deep indentations that might indicate long years of sharpening axes. Many carvings, such as this dancing depiction of what may be a deer, tapir, or anteater (left), were found on the walls and roof of the rock-shelter.





Marks of a Stone Age Kilroy, foot carvings are said by the Wasús to mean nothing more than "we were here." While some were scored in childlike fashion on hard rock (bottom), others on sandstone resemble actual footprints (below). A number of highly stylized faces, like this one on Abrigo's surface rock (right), may be images of masks worn by tribal witch doctors.



been extracted from the shelter, Eurico cannot know the whole story of Abrigo do Sol and the people who used it. At present, however, we can be sure that bits of charcoal dug from the shelter floor came from wood burned sometime between 9,000 and 12,000 years ago.

Carbon-14 tests put the age of one sample of charcoal at more than 14,500 years, but there is something troubling about this piece. For one thing, it was found at a level above those that yielded charcoal of much later origin; water and wind erosion can mix strata drastically, to the confusion of archeologists. Then again, laboratory error or a chemical change in the charcoal could have skewed the carbon-14 results.

Tantalizing Clue Needs Corroboration

In any event, Eurico hopes to find other pieces as old before he accepts the evidence of the single bit of charcoal as final. The issue is of considerable importance, for no other sites of human use as old as 14,500 years have been discovered in South America. The oldest proven sites found to date, in Peru and Venezuela, yielded artifacts 13,000 years old.

Some of the 8,960 sherds we have collected, the best of them from the nearby sites of old villages, tell us that the ancient Indians made excellent pottery; Nambicuaras of today make none. Designs, both on the pottery and cut into shelter walls, betoken artistic talent lacking in the modern tribespeople. We have found representations of a bird and animals we can't identify, possibly lizards, tapirs, and anteaters.

There are strange depictions of humans; the Wasúsus say they represent masks worn by witch doctors. Drawings of footprints deeply incised into rock (left) puzzled us, but not the Wasúsus.

"All they say is 'We were here,'" said Barbara.

Among the symbols on walls and pottery, there are many representing the sun (pages 67 and 72). Circles with rays such as any child draws to depict the sun, they offer evidence that the ancient people worshiped the sun. The Nambicuaras of today consider thunder the supreme being.

Nothing that we found in Abrigo indicated that the Paleo-Indians lived regularly in

the shelter, a deduction reinforced by our finding of old village sites not far away. We think the Paleo-Indians camped in the shelter on occasion and used it also for storing foods and other possessions. Neither do the Wasúsus live in Abrigo do Sol or in shelters nearby, although they apparently use them for certain rituals, which they would not tell us about even after all the time we spent with them.

In addition to the huge number of sherds, we collected nearly 8,500 stone artifacts, pieces of unworked stone probably gathered for raw material from the bed of a nearby stream, and fragments chipped from stones being worked. We found pieces polished and worn from being used to cut petroglyphs into the shelter walls. In addition to stone tools, the early people must have made pottery in Abrigo, for we dug up cylinders such as those used in rolling coils of clay for making ceramics.

Very rarely we came across snail shells, bones of wild pig and deer, and corncobs, all remains of meals eaten by Indians of fairly recent times. We also found a few bamboo arrow fragments and pieces of bows.

A puzzling find was a large boulder with deep cuts worked into it. The Indians said it was a ceremonial stone, but again they fell silent when questioned about the ceremony. Possibly this boulder was nothing more than a bit of hard stone on which the ancient people sharpened their stone axes and knives, but someone took the trouble to carve symbols into it (page 77).

Legend of Amazons Intrigues Author

Having no scientific reputation to protect, I can do a bit more surmising than Eurico Miller and the other experts who have visited this site. I think we may have found support for the old legend that warrior women once ruled in Amazonia. I base my theory on the fact that we have found countless stylized representations of female genitalia. Admittedly, these are not unique to Amazonia—they are used as fertility symbols in many parts of the world. But because there are far more of these symbols here than any other, I am quite sure women must have played a large part in the ancient societies of the Galera region.

The exploits of Francisco de Orellana in





Innocents in the rushing stream of progress, the once fierce, now pacified Nambiquara Indians have dwindled from an estimated 20,000 in 1907 to perhaps 500 or so today. Already ravaged by the white man's diseases of influenza, measles, and tuberculosis, they faced what might have been a final blow in 1958, when a new road across their lands opened the way for a flood of *fazendeiros*, or homesteaders.

On the open savanna, where this young woman crosses a rapid (left), ranchers now graze vast herds of zebu cattle. Below the plain, farmers and lumbermen are felling much of the mahogany-rich forests, where the Wasúsus traditionally catch fish by stunning them, first with poison, then with blunt arrows (right).

Efforts by the Brazilian Government to resettle many of the Nambiquaras on one reservation failed because of deep-rooted incompatibilities. In a turnaround, it adopted a policy of small reserves based on long-standing group differences. Restored to their forest wilderness, the Wasúsus now have much to smile about (above).



South America during the 1540's added to the mystique. Orellana, a Spaniard, was the first European to descend the Amazon to its mouth. Both Orellana and his chronicler, Friar Carvajal, reported attacks by women warriors like the Amazons of Greek mythology.

Brazilian Indians of today have a legend that a large tribe of women, who held in subjugation what few men they allowed to live, once ruled the Amazon jungles. They possessed magic flutes, the *jakui*, but in time the men took them from the women. Now no woman is ever allowed to see the *jakui*, which still remain in male custody and are played during secret ceremonies.

The Indians say the tribe of women was called *Iamuricumã*. Some Amazon tribes still hold ceremonies and dances that they call *Iamuricumã* for the mysterious women warriors of old.

Guard Duty Amuses Wasûsus

The time has come to leave the Galera jungle. In a deluge that heralds the beginning of the rainy season, I load my gear into my Brazilian jeep, a vehicle called *Xavante*, after a tribe of Mato Grosso Indians. All the Wasûsus except a few who are ill come to say good-bye.

We do not know when we will meet again, and several of us shed tears, although we all pretend that our wet cheeks are due to the rain. Eurico Miller has a big worry about leaving: Now that so many *civilizados* have come to the jungle of the Galera, the seekers of treasure and souvenirs may invade and damage his archeological sites, jeopardizing a successful conclusion to his three years of hard work.

When the Wasûsus learn the cause of our worry, they are amused.

"Remember how we frightened those who wished to cut down the mahogany trees?" Barbara says. "That made us laugh. If people come to the shelters while you are gone, we will be happy to scare them away, too."

Eurico and I drive off, he to his home in Rio Grande do Sul, I to my house in Goiás. We have no worries. We reason that if the Indians guarded their holy places against all outsiders for a hundred centuries or more, they can safely be counted on to do so for a few years more. □



Brotherhood of the flute: Following widespread Amazonian custom, Wasûsu men play sacred bamboo flutes (right); under pain of punishment, women stay indoors. After ceremonies the instruments are wrapped in bark (below) and hidden in special flute houses, which, according to the Wasûsus, are depicted by many carvings (above) at Abrigo. Indian legend has it that women once possessed the flutes and power over men.







the incredible crystal DIAMONDS

ARTICLE AND PHOTOGRAPHS BY
FRED WARD

BLACK STAR

HARRY WINSTON, the world's most famous gem merchant, touched the original Louis XV table in his quietly elegant office above New York City's Fifth Avenue, and

said: " 'Diamond' is a magic word today. Prices have never been higher, or risen so fast. Yet customer demand is exceeding supply. Even though I have people coming in to buy million-dollar diamonds for investment, most of my business is in quarter-carat and smaller stones selling for hundreds of dollars."

It seems that today diamonds are for everybody as well as forever.

Along with the almost frantic interest in gem diamonds has come an unprecedented proliferation of uses for the lesser-quality diamonds that literally make our industrial system work. Grinding, sawing, drilling, and polishing are the oldest and most common tasks, but diamonds are proving indispensable in exotic jobs as well:

- As America's latest Venus probe plunged through that planet's hostile atmosphere, it encountered searing heat and crushing pressures. On a mission to unravel mysteries of

Venus's dense cover, the instrument-laden capsule had been fitted with a transparent diamond window, through which infrared energy would pass to an on-board radiometer, an aid in determining the thick

clouds' composition.

Diamond was the only material transparent to infrared that could stand the cold and vacuum of space as well as Ve-

nus's atmospheric temperature of about 920°F (493°C) and atmospheric pressure a hundred times that of earth.

- In hospitals around the world, eye surgeons can now remove cataracts with super-sharp diamond knives whose edges are so even that no imperfections are visible at a thousand times magnification.

- A pinhead-size gold-coated diamond cube is an essential element in high-capacity miniature transmitters that carry television and telephone signals across the United States. Since diamonds have the greatest thermal conductivity of any material, they keep the tiny transmitters from burning up.

What is this amazing substance that turns the wheels of industry, advances science, and is the

(Continued on page 89)

*The true diamond is a hard,
diaphanous perfectly transparent stone,
which doth sparkle forth its glorie much
like the twinckling of a glorious starre.*

"THE HISTORY OF PRECIOUS STONES," T. NICOLS, 1651

Ace of diamonds: Harry Winston, New York merchandising mogul of the gem world, stands beside a box encrusted with 1,100 diamonds, made for Frederick the Great. Winston, whose insurance broker forbids his being recognizably photographed, has handled 60 of the world's major diamonds, more than any other dealer. The stone Pliny the Elder called "most highly valued of human possessions" remains the queen among jewels, as well as the consort of industry.



Priceless galaxy resides at the Smithsonian Institution. Marie Antoinette wore the earrings at far left. The Napoleon necklace, foreground with drop-shaped stones, rings a modern necklace. The 67.9-carat Victoria Transvaal Diamond hangs from the



necklace at right. Separate stones from left are: a 28.3-carat marquise cut; the 18.3-carat Shephard Diamond; the 16.7-carat Pearson Diamond; the 127-carat Portuguese, beneath a 2.9-carat pink diamond; and the 31-carat Eugenie Blue.





COURTESY DE BEERS LTD.

Greed spun a web that mantled the "Big Hole" of Kimberley in 1876 (above), ten years after the discovery of diamonds in South Africa. More than 1,600 claims, each 31 feet square in area and serviced by cables to the mine's rim, congested the site. Sides crumbled, causing cave-ins and deaths. Gradually claims were consolidated, until, in 1888, Cecil Rhodes bought out the other large claim holder, Barney Barnato, and established the De Beers Consolidated Mines, Ltd. Today the firm controls 85 percent of the world market. The town of Kimberley (left) nudges up to the abandoned mine's sides.

gem of choice for engagements and weddings—the symbol of love's durability?

The diamond has inspired courage, fear, and especially superstition. It is said that the 19th-century Afghan prince Shah Shuja endured blinding and days of torture before surrendering the Koh-i-noor, often called the world's most famous diamond, now in the crown of the Queen Mother of England. He explained his adamant stand with some illogic: "It brings good luck."

Even so desperate an optimist would not have been able to say the same about the Hope Diamond (page 112). Around it has been woven such a legend of intrigue, murder, and disaster that all its owners from Louis XIV to American heiress Evalyn Walsh McLean were said to find tragedy accompanying the fabled blue stone.*

And yet these mystic gems, like all diamonds, are simply carbon, one of the world's most plentiful elements. A colorless diamond is very pure carbon indeed, with exactly the same atoms as coal or graphite. (Impurities produce colored diamonds; nitrogen, for example, results in yellow stones.) What makes diamond a unique carbon is the way it was formed millions of years ago. Under intense heat and pressure of the earth's liquid magma, diamond atoms crystallized in a solid cubic pattern, giving the material its unsurpassed hardness.

The Four C's Determine Worth

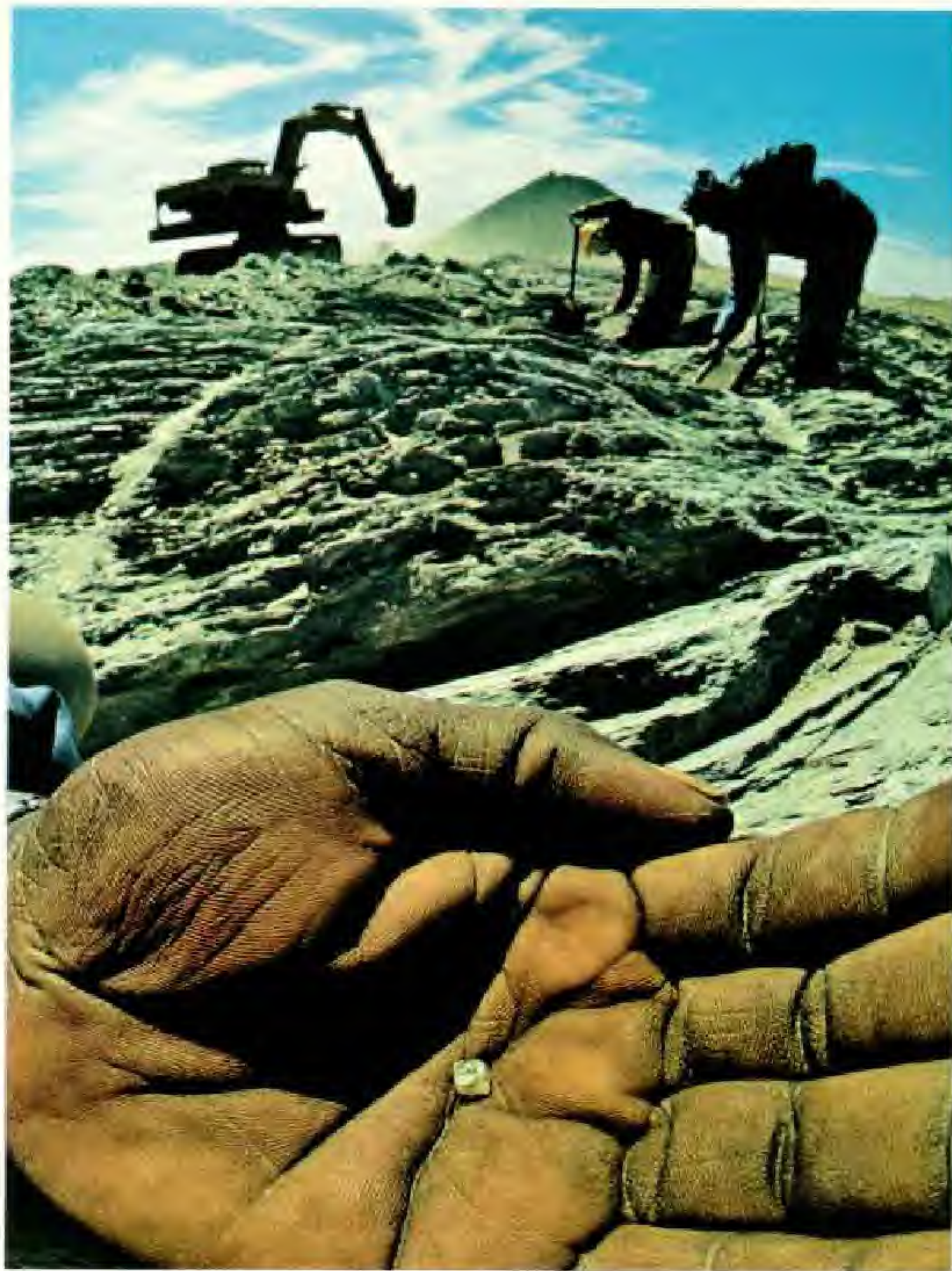
Diamond values are determined by the four C's: carat weight, cut, clarity, and color. Carat is an ancient term referring to the uniform weight of a carob seed. Now it has been set at 1/142 ounce, or 1/5 gram.

Cut refers to the quality of polishing and shape of the finished diamond. The four most common shapes are pear, emerald, marquise, and—most popular—brilliant, a round cut with 58 mathematically determined facets precisely formed to enhance diamonds' high refraction, thereby producing gems filled with fire and sparkle.

Clarity ranges from flawless (no visible imperfections under a ten-power loupe) to heavily flawed (defects visible to the unaided eye). The colorless diamond is generally the most valuable, except for the rare and

*See "Questing for Gems," by George S. Switzer, in the December 1971 NATIONAL GEOGRAPHIC.





Clean sweep in the search for diamonds: At the De Beers Consolidated Diamond Mines, a sixty-mile coastal stretch of South-West Africa—also known as Namibia—machines strip layers of sand as much as 85 feet deep to reach diamond-bearing gravel for removal to the recovery plant. At bedrock level (above) men whisk crevices and cracks for loose stones, such as the one-carat “pickup” in foreground. Last year’s harvest at this richest source of gem diamonds was worth 400 million dollars. A compound (left) outside Oranjemund, a town diamonds built, houses staff families.



Ever watchful against theft, the security system at the Orapa mine in Botswana uses TV monitors (above) and a sorting-house operation (facing page) that prevents workers from actually touching the stones. The men handle them with gloves built into locked boxes. A sampler of rough diamonds (below) shows the wonderful variety of shapes and colors.



extremely costly red, green, blue, orange, or other "fancy color" diamond.

No one knows when men began collecting diamonds, but it may have been as early as 800 B.C., around Golconda in India. There Indians systematically organized alluvial diggings that lasted until the early 1700's. Diamond-tipped tools and diamond-edged knives were in common use in India during this long period and were exported to China as jade-cutting knives.

Huge Stones Earned Quick Fame

Indian rulers quickly placed extraordinary values on the new stones, attributing luck, love, and power to the biggest diamonds, some weighing 200 carats and more. Among the many historical diamonds from India are the Hope, Orloff, and three owned by Taj Mahal builder Shah Jahan: Koh-i-noor, Great Mogul, and Shah.

As the Indian mines played out in the 18th century, rich new fields were being discovered in Brazil, producing many high-quality stones. But both areas were eclipsed by the sensational finds in South Africa that began in 1866. The first diamond, later named Eureka, was accidentally sighted among some rocks that children were playing with on a farm near Hopetown. It set off a rush of prospecting that altered the development of southern Africa.

As more mining areas were found and the potential for vast wealth loomed, haphazard searches by individual diggers created a patchwork of claims 31 feet square, just what a man with shovel and bucket could work, and each of questionable profitability. Consolidation was inevitable, and two legendary figures, the reserved Cecil Rhodes and the flamboyant Barney Barnato, vied for supremacy. Each bought up claims until 1888, when Rhodes outmaneuvered Barnato and thereafter bought him out with the largest check ever written until then—£5,338,650 (almost \$186,000,000 today). Rhodes called his new company the De Beers Consolidated Mines, Ltd., after the De Beers brothers, who originally owned the farm where two of the mines were located. Today in the trade the firm is known simply as the "Syndicate."

Another Englishman, the dynamic Ernest Oppenheimer, shaped the modern

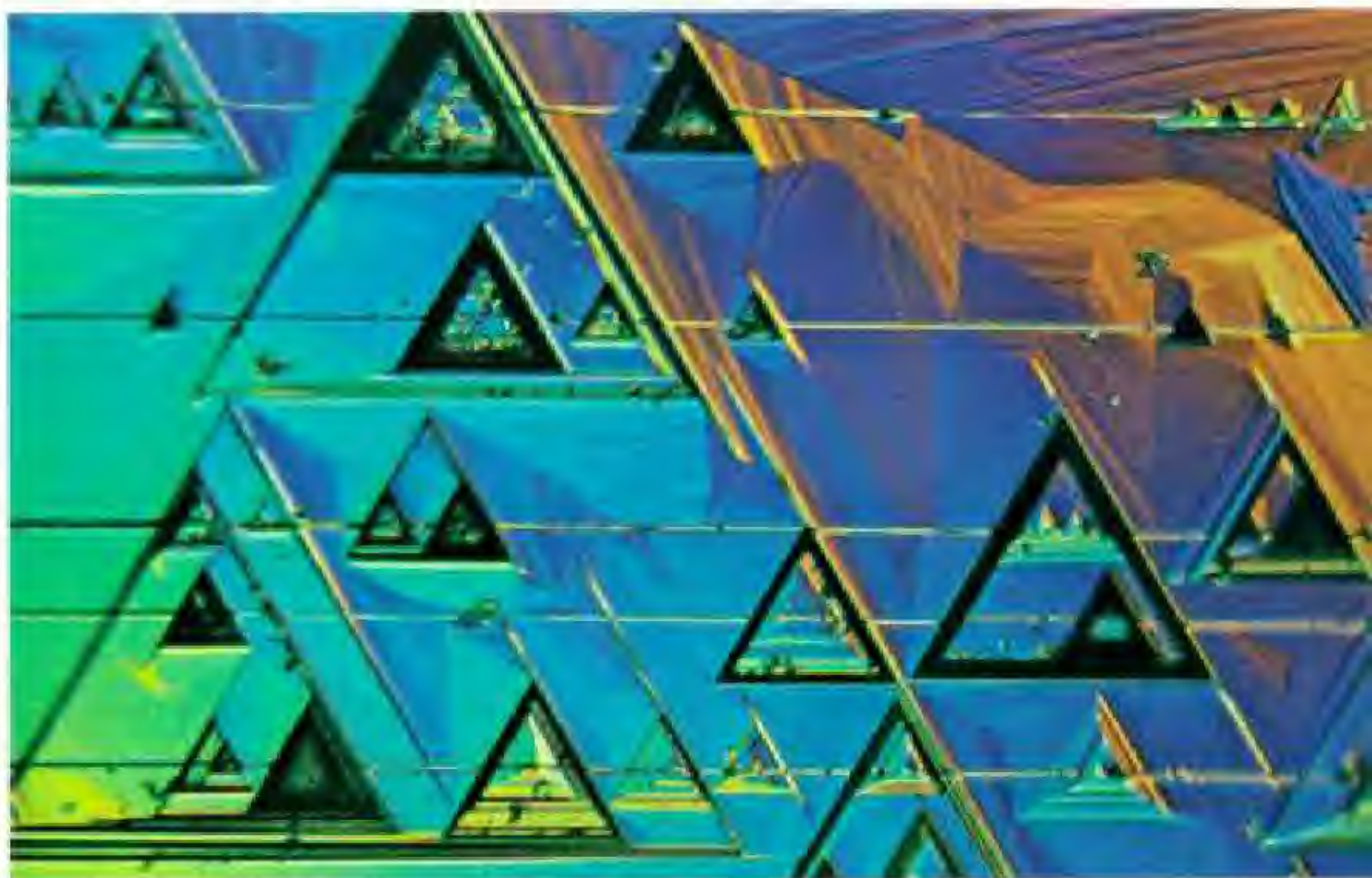


character of De Beers in the 1920's. Realizing the vast potential of American financing, he formed the Anglo American Corporation, which prospered in many mining pursuits, including gold, and soon began his business assault on De Beers. Seeking diamond areas De Beers might have overlooked, Oppenheimer bought rights to the alluvial deposits along the coast of South-West Africa, an area where German mining interests had already retrieved more than 6½ million carats. The vast desert became

includes De Beers and dozens of other firms (mainly in mining), the largest single stockholder is chairman of the board Harry Oppenheimer, Sir Ernest's son. Since 1957 he has run the complex from Johannesburg.

I met the chairman in his memento-filled office. A short, quiet man of 70, he was concerned with the criticism that power concentration brings.

"People call us a monopoly, but we cannot control production to any extent, nor can we control the market. We do have enough



Nature's finest crystal and hardest material known to man is actually pure carbon intensely compressed and heated in magma reservoirs deep in the earth. This photomicrograph—employing techniques perfected by medical-photography specialist Dr. Julius Weber—shows the typical final stages of surface crystalline growth.

the richest diamond region ever found.

Through Anglo American, Oppenheimer created the Consolidated Diamond Mines. With his financial backing, he forced his way onto the De Beers board and became chairman in 1929. By contracting with governments and mines to buy entire yearly production, he ended price fluctuations that had plagued the industry. De Beers now markets 85 percent of the world's diamonds.

In the Anglo American group, which

money to stockpile gems and control prices. The price fluctuations accepted as normal with other raw materials would be destructive of public confidence in the case of a pure luxury such as gem diamonds. If this is a monopoly, it benefits all concerned: producer, dealer, cutter, jeweler, and consumer."

Naturally, not everyone agrees with the chairman's view of monopoly. Although few people in the industry would openly criticize De Beers, numerous jewelers,

manufacturers, and dealers privately complained to me over the past year about the Syndicate's marketing policies. Considerable bickering centers around diamond supplies, which never seem to meet buyer needs. And gripes are most vocal over the recent price hikes, which many in the trade feel may be pushing diamond prices beyond the resources of most consumers. Insiders think that De Beers's increases of 34.5 percent in 1977 and 30 percent in 1978 went beyond inflationary adjustments and were



Fabulous in size, the world's largest uncut diamond weighs 616 carats. Inferior color and impurities reduce its value.

put into effect simply to make more money in the Syndicate's controlled market.

Owning a diamond mine may sound like a license to print money, but De Beers managers are quick to point out how increasingly difficult and expensive it is for them to find stones. At the Orapa mine, a large new De Beers operation located in central Botswana, I had a look at the problems.

Orapa, an isolated, dusty enclave rising like a mirage from the Kalahari Desert, is cursed with 120°F summer temperatures

and constantly blowing sand. According to the company doctor, the sand causes respiratory ailments strikingly similar to those he left in industrialized central England.

Twelve years of sleuthing went into locating the Orapa site. "We had found three diamonds in a riverbed in Botswana," said co-discoverer Jim Gibson, now divisional geologist for De Beers at the mine. "The traditional system is to trace their origin upstream to a volcanic source. Our leads dead-ended until we realized that a more recent land upheaval had changed the streambeds and we were looking too far east.

"Diamonds were formed in the upper mantle, beneath the earth's crust, and then carried to the surface in an underground column, or pipe, of diamond-bearing rock called kimberlite. Over the eons water may scatter the stones hundreds of miles, as it did here, but there is always a pipe source."

I stood at the edge of the mile-wide mine with pit superintendent A. P. Radull, one of two black managers. Ostriches grazed in the distance.

"Orapa has the second largest pipe in the world in surface area, exceeded only by the Mwadui [Williamson] in Tanzania," he said. "We're already producing about 2½ million carats a year. Pipes are funny things. This is only the fourth productive one found in Africa in this century. There are 28 other pipes nearby, but the chances are only one in two hundred that one will be profitable."

Premier Mine Richer Than Believed

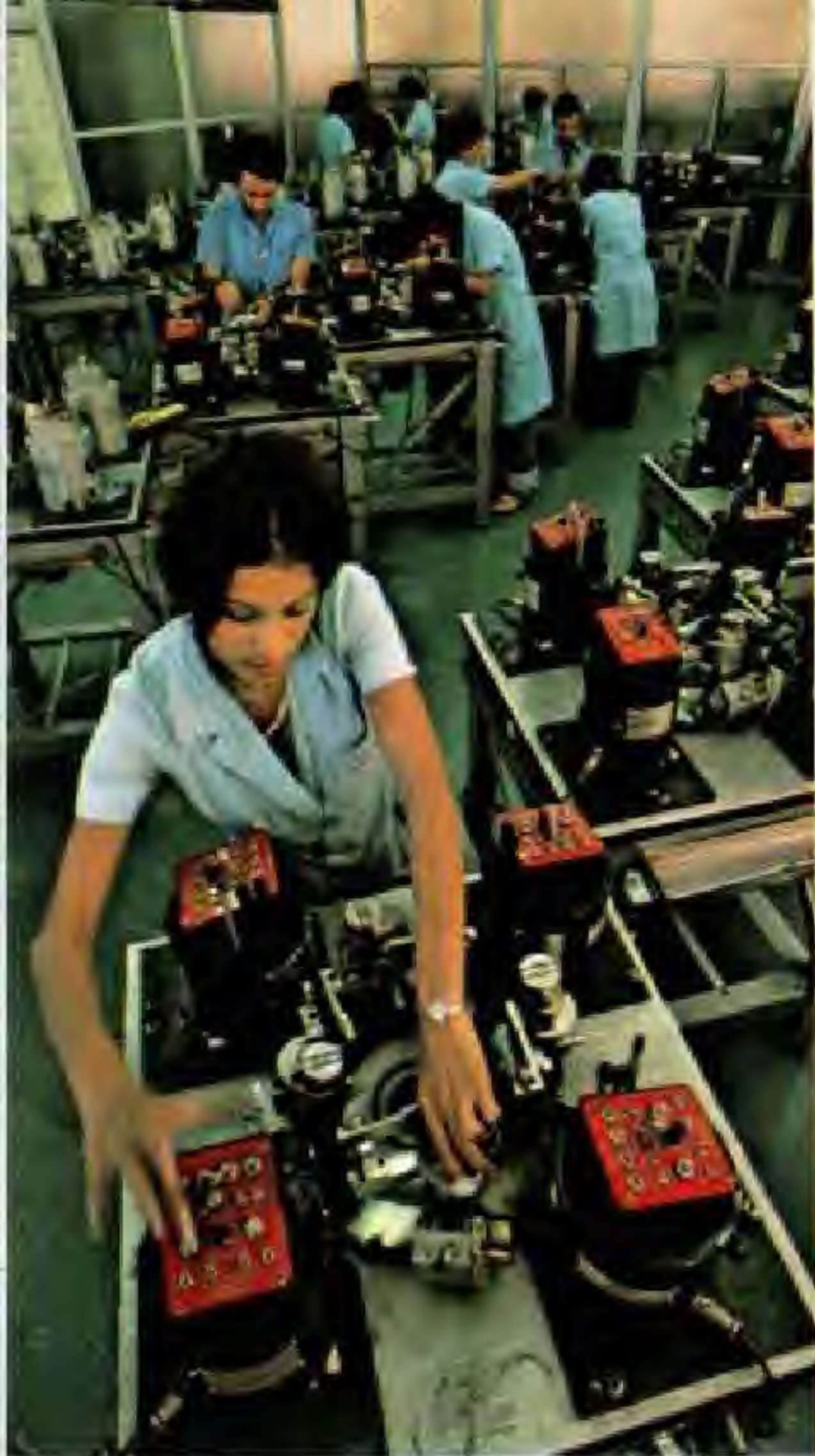
The Botswana Government has taken 50 percent ownership of the mine at Orapa, but De Beers wholly owns all 11 of its South African mines. At the Premier Mine near Pretoria, I descended 1,400 feet with development-section manager Hans Gastrow and walked in cool, spacious tunnels.

"Mining diamonds is comfortable compared to coal or gold," Hans said. "There are no small seams to contend with, and we stay in one area for years moving massive volumes of kimberlite. For every hundred tons we take up, we retrieve 32 carats of diamonds, about a fifth of an ounce. Only 30 percent are gems and the rest industrials, stones that because of size, shape, color, or imperfection may be worth only two or three dollars (Continued on page 100)

A discerning eye, trained by experience, aids a dealer (right) in gauging the value of a 3.5-carat marquise-cut diamond. If the four C's—carat weight, cut, clarity, and color—and price meet approval, a deal ensues, such as this one (below) at the Israel Diamond Exchange in Tel Aviv. The *Beurs voor Diamanthandel* in Antwerp (far right)—one of 16 diamond bourses, or diamond-trading clubs, in ten countries—claims 1,800 members. Though most transactions, particularly important ones, now occur in private offices, the bourse testifies to the tradition of trust as the bedrock of the business. Deals involving thousands of dollars may be concluded with no more collateral than a handshake.







Assembly-line diamond cutting at the Barmatz factory in Tel Aviv (left) sets a hundred automatic polishing machines to work on four stones at a time, turning out about 1,200 eight-point ($8/100$ of a carat) diamonds a day. The operation helps keep up with a market that has shifted from single large stones to settings of multiple small ones. Israel's largest export, diamonds generate more than a billion dollars a year,



mostly in meleees (lower left)—as cut stones of less than a carat are known. These have been given a round-shaped cut, called by the trade “brilliant.” Many such stones find settings in engagement-ring mountings (right). Wax coating the rings allows prongs to be plated with rhodium, a metal that highlights the gems’ whiteness. To deter theft, Charles W. Jahraus of Gemprint, Ltd., in Chicago “fingerprints” a diamond (above) by beaming a laser through a hole in Polaroid film onto a gem. The distinctive pattern each diamond reflects is recorded on film and filed.



(Continued from page 95) a carat as abrasives. But the Premier is the mine where many of the world's big stones originate. In 1905 a manager used his penknife to dig out of the wall the largest diamond ever found, the fist-size 3,106-carat Cullinan.

At the Premier, 15 to 20 walnut-size, 100-to-200-carat stones are still recovered each year; half are gems, worth more than four thousand dollars a carat in the rough.

More good news for the Premier came last year with the discovery of another trove hidden beneath the existing one. The new mine, perhaps twice as rich as the original, is believed to contain some 17 million carats.



"A work of art," actress Elizabeth Taylor (above) called the 33.19-carat Krupp Diamond gracing her hand. The glory of her collection, the 69.42-carat Taylor-Burton lies tucked away in a European vault and is on the market for a reported four million dollars. "Fancies"—the name given to colored diamonds—make a \$160,000 necklace and \$85,000 brooch unique (facing page). P. N. Ferstberg, dean of Antwerp dealers, designed them.

De Beers's Consolidated Diamond Mines (CDM) in South-West Africa, the original source of Oppenheimer's power, remains the "big daddy" of diamond mining, producing 13 percent of the world's gem diamonds. CDM also produces almost a quarter of De Beers's annual worldwide profits of 800 million dollars on sales of 2.5 billion.

With South-West Africans—backed by the United Nations—pushing for independence from South Africa as the new country of Namibia, De Beers recognized the need for cooperation with a future, possibly socialist or Communist government. Consequently, De Beers in 1977 moved its CDM headquarters from Kimberley to Windhoek, the capital of Namibia.

CDM is not actually a mine or mines but an area, sixty miles of barren, misty beach just south of Africa's Skeleton Coast, so called for the shipwrecks that have dotted it for centuries.

Gemstones Survived Nature's Violence

As I drove with De Beers official Derek Erickson past barbed-wire security fences onto the sand-dune diamond concession area, he told me: "We produce about seven thousand carats daily, or two million carats annually. But what makes CDM so profitable is that, unlike any other mine in the world, 95 percent of our stones are gems.

"What happened to the industrial diamonds that must have been formed with our gems? We think that structurally weaker industrials just didn't survive the thrashing about in rivers and on the beach when they washed here from inland. A test matched six gems in a tank against six industrials, beach gravel, 265 pounds of steel balls, and water. After seven hours of tumbling, the industrials were gone, but after 950 hours, the gems had lost only one-hundredth of one percent of their weight."

CDM mining is basically an earth-moving operation. As much as 85 feet of sand overburden is removed to expose the gravel that bears diamonds. The latest technique is "paddock" mining, where dams are built 300 yards into the ocean, water and sand pumped out, and diamonds mined at fifty feet below sea level.

Machines can only do so much. The final retrieval is done by men, black men, who



sign on for six, nine, or twelve months and live inside the fence until their contracts expire. Since they receive room, food, and recreational facilities free, they can take home most of their salary, which starts at \$170 a month. When the machines hit bedrock, it is time for the work crews.

I sat with one 24-man crew to watch the activity. A burly fellow in a beret, with a quick grin, sat down beside me. He had a leather pouch slung over one shoulder. "I'm called Headman," he said as his men started work. "If they find any diamonds, or 'pick-ups,' I put them in this pouch."

The men fanned out over the exposed rock of the ocean bed, wielding small shovels and brooms to remove every particle from each of millions of tiny cracks and crevices (page 91). Last year a single tidal pool one yard in diameter yielded 2,700 diamonds weighing 3,000 carats.

As I crawled around the rocks hoping to locate a sparkling treasure, a worker shouted out, and Headman and I ran to see the find. I held the slightly rounded one-carat octahedron before Headman tucked it into his pouch. "We used to have lots of pickups, when we got bonuses for the number of stones found," Headman said. "Now we get a bonus for area covered, so no one takes much time looking for diamonds." Under the new system, the gravel is simply swept up and later examined for gems in the plant.

Tight Security Is the Rule

Alluvial fields are the only mines where workers come into direct contact with diamonds; in underground pipes employees mine kimberlite for years without seeing a single stone. I asked CDM's security superintendent, John Danckert, to show me the precautions against theft. We entered the exit building just as a worker would after completing his months-long contract. Soothing music, chosen for psychological effect, plays as all belongings are subjected to powerful X-ray scan.

After inserting a computer-coded identification card, the worker goes through an open door and finds himself inside a U-shaped corridor, surrounded by one-way glass. As a readout of his work history flashes on TV monitors, security men keep him under constant surveillance to see



NATIONAL GEOGRAPHIC PHOTOGRAPHER JAMES L. STANFIELD CAPTURED

Symbol of sovereignty, Iran's Pahlavi Crown of State (right) blazes with the radiance of 3,380 diamonds, including the pale yellow 60-carat gem in the sunburst. Worn by Mohammad Reza Pahlavi at his coronation as Shah of Iran in 1967 (above), the crown matches in beauty the diamond-studded scepter, sword, and Nadir Throne. Displayed in the Central Bank of Iran in Tehran, the crown jewels help back the nation's currency.





Technology commands services only a diamond can fulfill. A diamond-studded dentist's drill, magnified 35 times (left), demonstrates its clean, quick cutting efficiency on an extracted human tooth.

The D. Drukker Company of Amsterdam specializes in exotic uses of industrial diamonds. Sensitive to the minutest temperature change, a chip of diamond (below, far left) will be installed in a high-altitude telescope where it will transfer the heat radiated by a star to a recording device. Diamond's ability to bear a sharp, finely boned edge makes it ideal for delicate cataract surgery. Tipped with a 1/20-carat diamond, the scalpel (near lower left) can slice through tissue without tearing it. Another of the crystal's attributes, unsurpassed heat conduction, makes diamond an integral part of a miniature transmitter's diode, here sitting on a fingertip (lower right). It is used to carry electronic signals relaying telephone conversations and television signals. The dimpled tray holds pinhead-size, gold-plated diamond cubes called heat sinks, which draw off the heat and prevent the transmitter from burning up. Besides its ability to tolerate the extreme heat and cold of space, diamond, because of its transparency to infrared, is perfect material for a window, mounted in a metal frame (upper right) and used in the latest Venus probe.





whether he acts suspiciously or drops anything on the dark brown rug. If no unusual act occurs, and if the computer does not select him for a random search, an exit door opens and he is free to go. If, however, an inspection door opens, either a hand search or a full body fluoroscopic search is made.

Until recently, diamond recovery was done on vibrating grease tables; diamonds stick to grease while a slurry of water and gravel slides past. At most of the De Beers plants, crushed stone (including a few unavoidably crushed diamonds) is now passed through a darkened chamber and X-rayed. Photo sensors detect a diamond's faint fluorescence and trigger an air jet to eject it.

At Kleinsee, on South Africa's northwest coast, I sat with sorters in a room below the X-ray machines as diamonds plunked down a tube into a waiting can. The gems and industrials were then sorted out by hand. At Orapa I joined six sorters and a security guard in a newer, theft-free system where workers never directly touch the diamonds. The sorters' gloves are permanently attached to a locked glass box. Diamonds and gravel come into the sealed top, and the diamonds are then sorted out and dropped into collection boxes (page 93).

Diamond Roads Lead to London

South African and South-West African diamonds, including those from the South African Government's only mine, are sent secretly to Kimberley for valuation. When the government representative is satisfied the valuation is accurate for taxes, the diamonds are grouped by color, quality, and shape, and the majority flown to London.

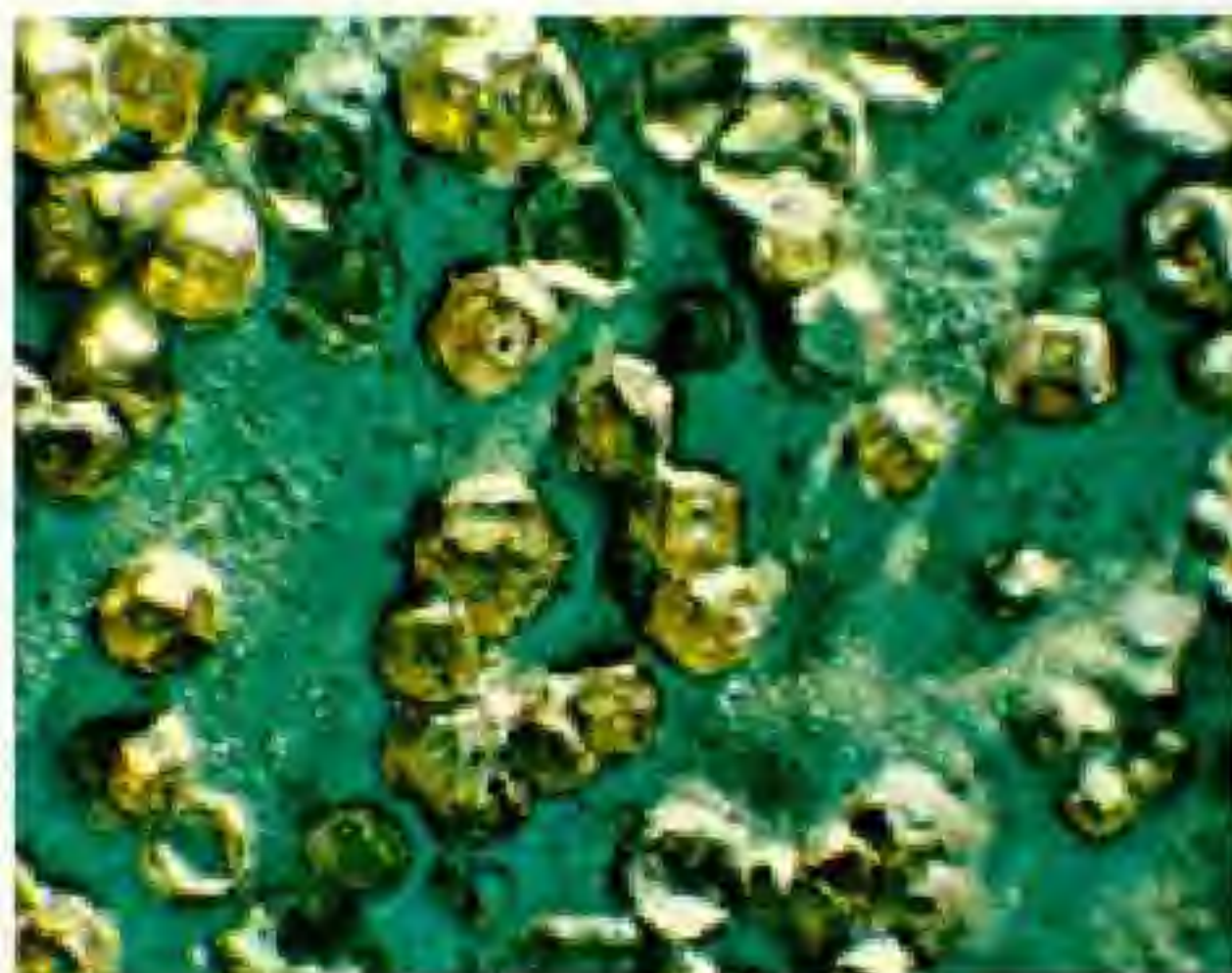
At De Beers's fortresslike London headquarters on Charterhouse Street, electronic surveillance devices monitor vaults, doors, halls, and offices. I was dazzled as I entered the large sorting room literally aglow with the brilliance of tens of thousands of uncut diamonds. On a counter running the length of the building, keen-eyed workers faced north windows for the indirect, even-color light needed to sort piles of roughs.

Eight central tables were laden with sparkling crystals. "That is basically the world's five-week production of gem diamonds between two and nine carats," Syndicate official Robin Walker explained.





How to make a diamond? Bring pressure of a million pounds per square inch to bear on graphite as the material is heated to 2500° to 3500°F. The result—1/2-mm synthetic diamonds embedded in a matrix (lower left), whose metal acts as a catalyst in the process, pioneered by General



Electric in 1954. This press (upper left) at a De Beers plant at Shannon, Ireland, has been modified for the picture, since the making of diamonds is a closely guarded trade secret.

Natural industrials, called bort (above), comprise more than 70 percent of all diamonds mined. Sold in bulk, industrials weigh in at as low as fifty cents a carat (200 mg) for low-grade powder used in abrasives to \$200 or more a carat for diamond employed in exacting technology. Gem-quality synthetics, another General Electric first, take a week to produce under these conditions, making them more expensive than the naturals.

"There are 180,000 carats on those layout tables, worth about 70 million dollars. When we have all the stones together for next month's 'sight,' or sale, including very small stones and stones over 100 carats, they will bring 250 million."

De Beers's Central Selling Organization (CSO) buys from most of the world's mines. At the London headquarters, the production of Zaire, Tanzania, the Soviet Union, Sierra Leone, South Africa, and several other countries creates the collection De Beers markets to the world.

Michael Grantham, a CSO sales manager, told me: "Naturally, prices continue to rise. Our costs increase, mine owners want more for their diamonds, and inflation persists. For stones under 14.8 carats, we set the price, and it is not negotiable. Special stones, over 14.8 carats, are offered only to the usual buyers of our large stones; we set a price, but it is negotiable. Not too negotiable, since the big stones are becoming fewer and fewer.

"A huge problem is weight loss," Michael said, "an average of 50 percent in most stones in cutting for the best shape and in polishing facets. It's possible to produce a one-carat brilliant from an uncut 2-to-2½-carat octahedron. Our 1977 price for the best colorless 2½-carat rough was \$750 a carat. By the time a rough is polished, the price can jump about six times." What with panic buying, some perfect-color, flawless one-caraters are even selling as high as \$20,000.

Demand Outstrips Supply

Diamond sights are conducted in the privacy of second-floor offices at the Charterhouse Street headquarters. There De Beers representatives meet the clients over coffee in a richly paneled room furnished with antiques. Two or three weeks earlier, the buyer had to apply to De Beers with his list of requests, knowing full well that all the diamonds requested would not be delivered. Supply never quite meets demand in the tightly controlled De Beers market.

I sat in one of the tiny rooms, cardboard boxes of diamonds spread before me. With them came a computerized list of the contents of the parcels by numbers, weights, colors, qualities, and prices. I looked at individual diamonds, resting in white folded

papers, using a ten-power loupe just as a client would and carefully checking the diamonds against the price sheet. Unless there is a dispute over classification of a stone, the parcels are either accepted in their entirety for the Syndicate price or rejected. Once a client accepts, he has one week to pay in United States dollars.

Individual sights can range from twenty-five thousand dollars to the all-time high of sixty million, for an average of about a million dollars a parcel, at each of the ten sales a year. Of some 330 "sightholders," 64 are in the U. S., 58 in India, 51 in Israel, and 90 in Belgium. The U. S. gets most of the big stones, and the difficult or speculative ones. Antwerp specializes in cutting the odd shapes. Since World War II Israel has made an industry of polishing meleees, roughs under one carat. And as many as 300,000 people in India polish the smallest goods, twenty to fifty stones to a carat.

U.S.S.R. Production Increases

Soviet diamond production, chiefly in Siberia, has been phenomenal, but all information about diamonds is considered secret. We do know, however, that even though the U.S.S.R.'s first pipe was discovered only in the 1950's, Soviet production exceeds that of all other countries except Zaire, the industrial-diamond giant. The U.S.S.R. mines about 20 percent of the world's diamonds, or ten million carats annually, of which 25 to 30 percent are gems, many of the highest quality. In addition, the Soviets manufacture at least 15 million carats of synthetic diamonds.

Until 1963 the U.S.S.R. openly marketed its gems through De Beers, but black African pressure to boycott South African businesses drove the Soviets underground. They now export gems to a London-based company, which then sells them to the Syndicate. Such sales netted the U.S.S.R. half a billion dollars in 1977.

No success has been more dramatic than the rise of Israel's diamond industry, a by-product of World War II. Historically a Jewish business in Europe, diamond working virtually stopped with Nazi occupation. Jews from the Low Countries who fled to Palestine brought their skills along and formed a new diamond industry. Now Israel

claims that it leads the world in diamond finishing and polishes half the world's caratage, exporting more than one billion dollars' worth a year. Its diamond industry employs twenty thousand people, about 4 percent of the national work force, and produces 40 percent of the country's exports.

Moshe Schmitzer, the best-known dealer in Tel Aviv, echoed diamond dealer Harry Winston: "We are in a boom. Diamonds are no longer for royalty or rich people; they are also for saleswomen and young couples who can afford jewelry costing only five hundred or a thousand dollars."

Before the Nazi occupation, Antwerp shared with Amsterdam the reputation of diamond capital of the world. Amsterdam never recovered and now probably supports only some two hundred diamond workers. Antwerp, having lost many of its Jewish craftsmen to concentration camps or by emigration to Palestine or New York, has been struggling to rebuild.

Today Antwerp, whose diamond workers enjoy a reputation for unsurpassed craftsmanship, has become known among certain business interests as a diamond black-market center. Diamonds are small and valuable enough for one ounce (142

carats) to be worth more than a million dollars, and so are easy to exchange, no questions asked. But sometimes a question is irresistible. One dealer told me of an African who arrived in his office in tattered clothes and produced an elaborate matched diamond necklace, earrings, and ring for sale. The dealer admired the workmanship and stones and asked their origin. "Family heirlooms," said the smiling young thief.

Generally, if one has a diamond that needs selling quietly, or money to invest without a sales slip, Antwerp is accommodating. In some financial circles large amounts of money are accumulated, legitimate or otherwise, and an investment in stocks, real estate, or a bank account would mean records and taxes. Large diamonds bought in Antwerp for cash with no sales receipts offer investment opportunities usually omitted from the textbooks.

Depreciation Isn't a Problem

P. N. Ferstenberg, the genial dean of Antwerp's *diamantaires*, said, "Diamonds are the best place to put 'submarine money.' It probably accounts for a third of this city's sales. Buy a \$200,000 fur, and in ten years you have a rag left. Put that into a diamond,

Sight as well as sound will play off the tip of a diamond stylus when RCA fine-tunes its SelectaVision VideoDisc line. A technician (right) monitors a copper master capable of pressing hundreds of thousands of disks for playing through a television set. A disk with information compressed in grooves only 1/10,000 of an inch wide holds two hours' play. Diamond is the only material that can be machined small, sharp, and strong enough to tolerate the incessant abrasion and resulting pressures that build up in tracking the grooves.

Set on an ordinary phonograph record, an elliptical diamond enlarged 120 times (facing page) rides its peaks and valleys. Stylus-quality stones average 517 a carat.



and in ten years you have a stone worth several times as much."

To see what some of today's princes of business are buying in diamonds, I visited the cramped, double-locked, windowless sawing room above Harry Winston's New York store. There Morris Greenfield was hunched over a whirling flexible disk of phosphor bronze and copper. "Come, look," he beckoned. "This is really a special stone."

I could hardly believe this palm-size crystal, 341.9 carats. Adding olive oil and diamond dust to the disk, Mr. Greenfield continued his sawing. "Nothing will cut a diamond but another diamond. This dust and flimsy disk will cut through our inch-and-three-quarter-thick stone in six weeks."

Two months later I watched with Harry Winston as the two pieces took shape on the polishing wheel. "Harry Oppenheimer called me when De Beers recovered this diamond," Winston recounted. "Knowing my reputation for dealing in large diamonds, he said, 'Harry, we found a stone with your name on it.' I'll make two pear-shaped stones from it, about five months' work."

Both diamonds ultimately were sold to anonymous buyers for several million dollars each. The larger became the 89.23-carat

Washington Diamond, and its selling price still remains a secret.

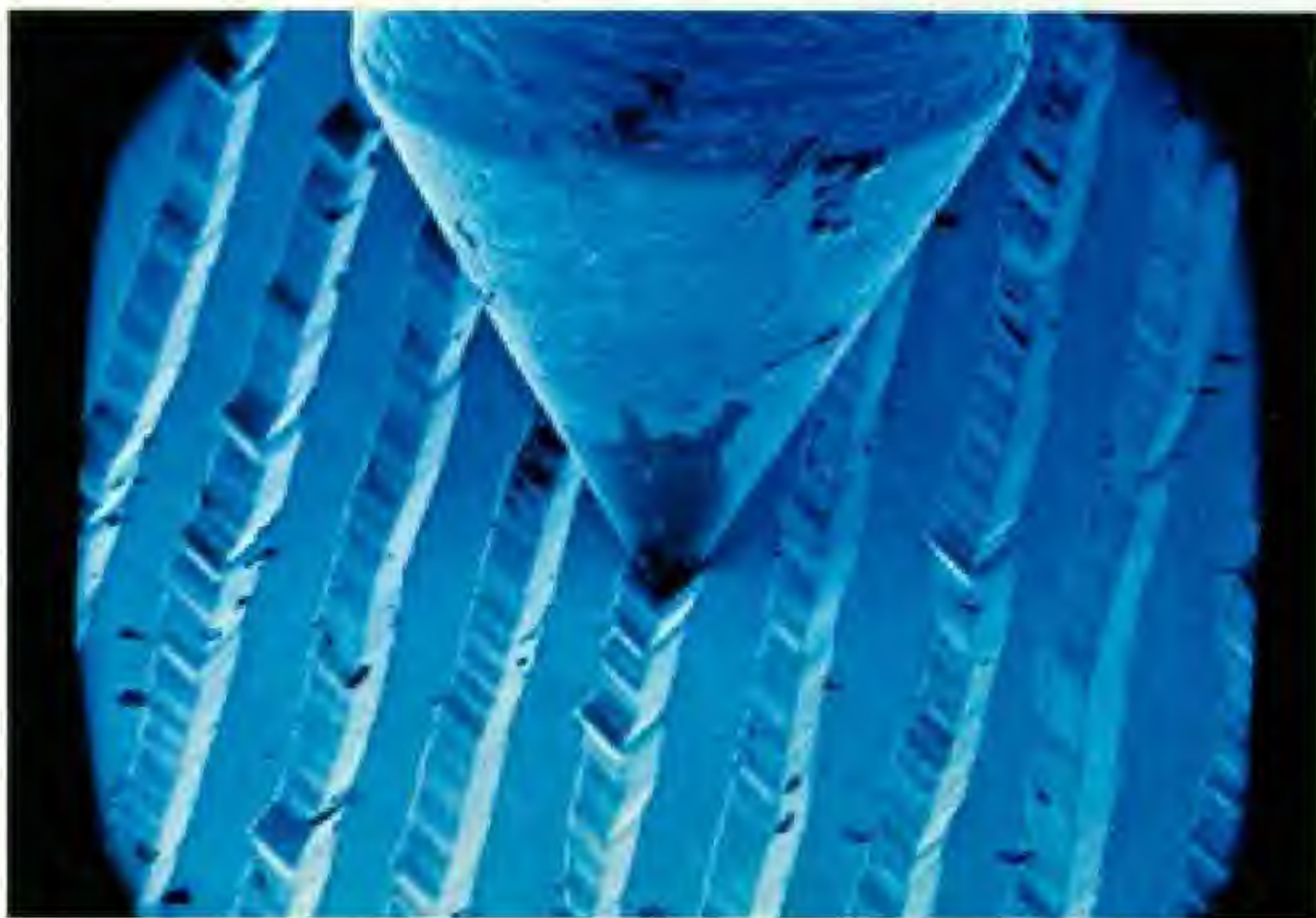
But Mr. Winston's last big-stone sale—the Star of Independence, in 1976—brought the highest price paid for a diamond up to that time. The 75.52-carat Star reportedly went for four million dollars.

"You can see what's happening," he said. "Gem diamonds are soaring. In 1974 the retail price for a flawless one-carater was \$9,000. Now it's \$19,000 or more. Perfect stones of more than five carats are selling for \$35,000 a carat and up, when you can get them. The big expensive diamonds are being bought increasingly by people who believe these rare, perfect stones will appreciate faster than real estate or stocks."

But De Beers official Richard Dickson pointed out: "We never advertise diamonds as an investment, even though prices have continued to rise since the 1930's. The average consumer has to buy at retail and sell at wholesale or less. So there are few real bargains."

Diamond Clubs Arbitrate Disputes

To facilitate the movement of diamonds among buyers, dealers, manufacturers, brokers, and jewelers, 16 diamond clubs,





Grinding out the bumps in an old, uneven road requires cutting corduroy-like ridges. A rig pulls 180 12-inch diamond blades used to rehabilitate a much used highway in Georgia. "An impossible job without diamonds," says Jim Parkhurst, job foreman for C. W. Hatcher, Inc., of California.

or bourses, have been established in ten countries. Two are located in New York's carnival-like diamond center. On West 47th Street, between Fifth Avenue and Avenue of the Americas, it is a gaudy place of bright lights, hawkers, and arrogant salespeople. Al Lubin, executive director of the Diamond Dealers' Club, and I toured the main floor, where dealers, many of them Orthodox Jews with long beards and black frock coats, animatedly examined envelopes of stones and agreed on prices.

Al explained: "One of any bourse's main functions is arbitration. Members with a dispute appear before two elected officials for conciliation. If conciliation fails to occur, a panel of three arbitrators is formed. A final appeal, very rare, can be made to a panel of five members.

"If a man is suspended or expelled, blue notices with red stripes are immediately sent to all the other bourses in the world, and that man has a hard time dealing in diamonds. We accomplish in a few weeks what a court would take years to complete, and we don't tie up a man or his diamonds."

Murders Resulted in Better Controls

Al told me that security in the bourse had been greatly increased. "Part of it is due to the unfortunate events in 1977 when two dealers were robbed and killed. The diamond district of 47th Street is now probably the most protected block anywhere. Our club has forty hidden buttons, any one of which will bring the police instantly. Two uniformed policemen patrol the street, with another at each corner. Four plainclothes officers, including one woman, mingle with pedestrians at all times, and all the buildings are now getting uniformed guards, TV in the lobbies and elevators, and electric locks on all the doors."

Across the street, at New York's other bourse, an official of the Diamond Trade Association asked that his name not be used for fear of criminal attack. "After the murders, TV reports made it look like everyone on 47th Street walks around with a million dollars in his coat, which is absurd. People do get robbed here, but few report it because they're afraid dealers won't trust diamonds to anyone who's been robbed."

Even though 80 percent of diamond

transactions now occur in private offices, I was able to see several in progress on the bourse floors. Concluding a diamond sale, a pair of dealers stood up, and with the traditional Hebrew phrase *mazel und brache* (luck and blessing), a clasped hand, and deep trust, the diamonds changed owners with a promise to pay at a fixed future date.

History That Sparkles

The fascination with diamonds extends far beyond the bourse and jewelry store. At Johannesburg's Witwatersrand University, professor of nuclear physics Friedel Sellschop is intrigued by diamonds' molecular structure. "Diamonds provide us with a built-in history of the earth's upper mantle," he said. "When they were formed, 70 million to 1 1/4 billion years ago, they locked inside their crystals tiny droplets of the other materials that surrounded them. As we discover what diamonds hold inside and in what amounts, we will know what was in the earth's mantle then, and perhaps now. We have already identified more than fifty impurities. Nitrogen appears in microscopic amounts and produces yellow tints. Boron turns some diamonds blue, such as the Smithsonian's Hope Diamond, and makes them electrical conductors."

In industry, almost every product is in some way touched by diamonds. In grinding, grooving, cutting, sharpening, etching, and polishing, their unequalled hardness has thousands of applications. The stonecutting, metal, ceramic, glass, and concrete industries alone buy 90 percent of the industrial diamonds consumed.

Industrial diamonds today can be either naturals (called bort), found in the mines as by-products of gem mining, or synthetics (page 106). More than 70 percent of all diamonds found are industrials and are virtually a De Beers monopoly. Some countries, such as Zaire and Ghana, produce almost all bort and few gems. De Beers sends industrials to the airport tax-free zone at Shannon, Ireland, where sorting and selling is combined with one of the Syndicate's three synthetic diamond plants.

The general manager at the Shannon plant told me: "The world is moving toward synthetics. Demand rises as more countries industrialize, but the diamond mines cannot



Diamonds aren't forever, at least not in rock-munching oil-rig bits. But they do last many times longer than conventional steel roller bits. Studded with 312 carats of diamonds, this 8 1/2-inch bit made by Utah-based Christensen Diamond Products, U.S.A., spearheads a search for oil in southern Louisiana.

ew Owner of the
Fateful Hope Stone

s. McLean Brings Beauty and
Riches Into Company With Fate



keep up. Since 1954, when the first synthetics were produced, free-world sales have risen to forty million carats annually."

Looking down a towering row of automatic Swedish presses, he explained synthesis. "Graphite, which is pure carbon, and a metal solvent are placed between tungsten-carbide pistons, subjected to a pressure of about a million pounds per square inch, then heated to 2500° to 3500° F [1370° to 1930°C]. The graphite changes as thousands of diamond crystals grow to micron size [one millionth of a meter] in a few minutes. One-carat diamonds are possible but take a week under these conditions, which are extremely difficult and expensive to hold."

In the plant storage area, I saw plastic buckets each filled with about \$400,000 worth of pencil-tip-size yellow synthetic crystals. "The average cost of all industrials is about three dollars a carat," the manager said. "But phonograph-stylus diamonds sell for about \$17 a carat. They are almost microscopic—three hundred to a carat."

The Diamond as Thermometer

Other practical uses of diamonds, both synthetic and natural, are astonishing. NASA uses a paper-thin diamond disk to help measure the temperature of stars (page 104). When a telescope, flying in a jet above most of the earth's atmosphere, is focused on a star, the diamond sliver is placed in the light path. It transfers the infinitesimal heat increase to a detector, thus measuring the star's temperature.

Diamond is the best thermal conductor, and diamond thermometers can instantly detect temperature changes as small as one-thousandth of a degree. Since some diamonds are highly sensitive to radiation, a diamond dosimeter inserted directly into a human tumor can read the amount of radiation being delivered during therapy.

Most diamond applications are not so dramatic as these, but they can be as vital.

At the Shreveport, Louisiana, airport I watched Joe Pacino of Pavement Specialists, Inc., run a rig equipped with 48 diamond-edged blades. He was grooving the runways to prevent dangerous hydroplaning and skids. And just a bit farther south in Louisiana, I saw oil and gas drillers sink wells more than 20,000 feet through hard-rock formations of sand and shale, an almost impossible feat before the diamond bit.*

In Corning, New York, at the Steuben Glass factory, I rubbernecked while an artist stippled fine crystal, creating an image by removing thousands of tiny chips or dots from the glass with a sharp diamond tip. In Georgia, the carving was on a more monumental scale: Banks of huge diamond-tipped saws slowly sliced uniform slabs of marble destined to face new buildings and mark graves in cemeteries.

A Better-than-ever Friend

And, finally, back home in Washington, D. C., I joined a happy young couple choosing their first diamond, an engagement ring, now a universal symbol of love and commitment. For most people, this will be the only gem diamond they will ever own.

Today's newlyweds are continuing a romance with diamonds that began 3,000 years ago. The same fascination that ancient Indian rulers felt for the sparkling treasures of their legendary Valley of Diamonds later captivated kings and queens of England, France, and Russia. Lorelei Lee, the blonde that "gentlemen prefer," touched a very human chord when she whispered, "Diamonds are a girl's best friend."

Now the world has new reasons to value this amazing carbon substance, for industry would truly grind to a halt in its absence. All in all, that is quite a contribution from one incredible crystal. □

*See "Natural Gas: The Search Goes On," by Bryan Hodgson, NATIONAL GEOGRAPHIC, November 1978.

Bedeviled by fate, the Hope Diamond is a steel-blue 45.52-carat stone, regarded by one admirer as "unearthly . . . with millions of sardonic winks." Here it rests on a clipping—snipped by its last private owner, Evalyn Walsh McLean—that calls the jewel "fateful," in recognition of a jinx that associated it with a long history of murder, suicide, and scandal. The Hope now joins other great diamonds in the role of pleasure giver, displayed for all to enjoy by the Smithsonian Institution.

BISON KILL BY ICE AGE HUNTERS

By DENNIS STANFORD, Ph.D.,
DEPARTMENT OF ANTHROPOLOGY, SMITHSONIAN INSTITUTION

TO THE SWELLING THUNDER of hooves, the hunt chief climbed to a perch atop the medicine post. Clad in a buffalo-skin robe and headdress, he shook a staff adorned with feathers. Noted among his people for having the power to lure prey, the shaman clung to the ritual post that had been planted beside a stream-bed drifted deep with snow.

Shouting hunters drove the stampeding bison between crude fences of sticks and brush as women, children, and older men yelled and waved hides. In a frenzied surge the herd swept past the medicine post.

Snow on the descending slope had been packed hard by the hunters. Down this glistening ramp the animals slid helplessly to flounder and thrash about in the soft snow at the bottom of the draw.

A score of hunters swiftly attacked with spears and spear-throwers (pages 118-19). Soon the slaughter was done. With sharp stone blades the people stripped tongues and livers from several of the animals and satisfied their urgent hunger. Nearly a hundred bison had been slain—meat and hides enough to feed and clothe the Indians for several winter months.

This scene from about 10,000 years ago—at the close of the Ice Age—re-creates a winter hunt of Paleo-Indians in wooded bottomlands of the Arikaree River in northeastern Colorado. While I cannot assert that these

PAINTING BY ROBERT C. BARRIS
NATIONAL GEOGRAPHIC ART DIVISION







(LEFT, TOP) (RIGHT)

Imprisoned in a bed of bones, a broken spearpoint (above) lies where it fell thousands of years ago. Discovered by Colorado rancher Bob Jones (top), here with Mrs. Jones and the author, right, the bones came from some three hundred animals, probably killed in a single winter.



events occurred exactly as described, excavations I conducted over three summers have produced evidence strongly supporting such a hypothetical reconstruction.

Curious Farmer Makes Discovery

I became involved in these prehistoric happenings as a direct result of a farmer's alertness and curiosity.

The summer wind blew hot as Robert B. Jones, Jr., leveled off a ridge on his ranch near Wray, Colorado. His scraper blade turned up some large bones, but he paid them little heed.

That afternoon a violent thunderstorm struck and quickly passed. As Bob headed back toward his pickup truck, rays from the declining sun reflected on bones washed clean by the rain. But something else gleamed—the sharp tip of a stone spearpoint. Bob found another and yet another spearpoint. The bones, he guessed with mounting excitement, were not those of cows at all, but the remains of buffalo killed long, long ago. Just *how* old were those bones and spearpoints?

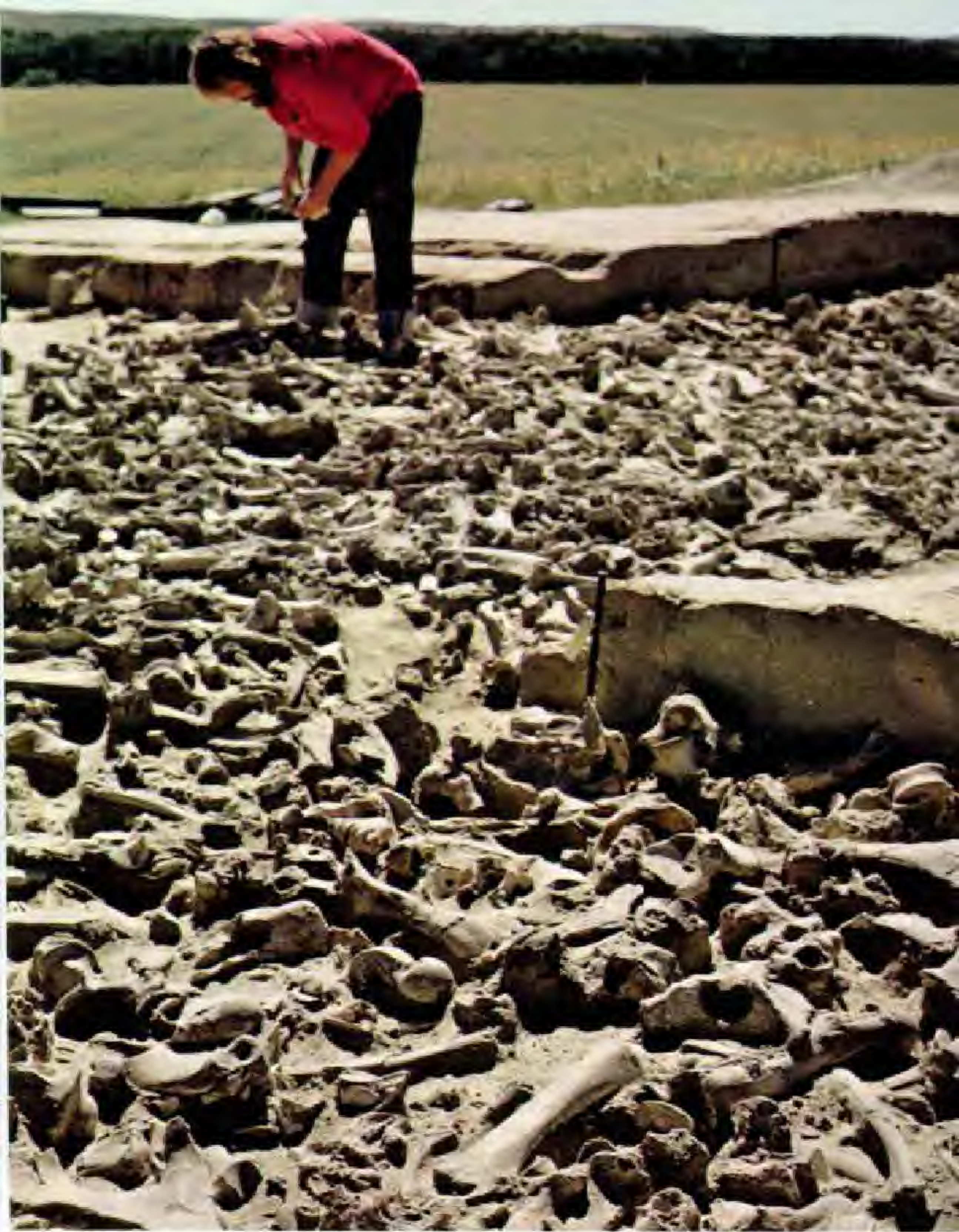
Bob called in Jack Miller, a local anthropologist, who conducted preliminary excavations and confirmed that the remains were indeed ancient and possibly of great significance. Miller then phoned me at the Smithsonian Institution.

"There are bones all over the place!" he exclaimed. "And Hell Gap spearpoints, too." Miller referred to weapon points of a type that were first found at Hell Gap, Wyoming. The Jones-Miller location is one of only five sites where these distinctive weapon points have been found. The little-known people who made them hunted buffalo at least a third larger than modern bison.

I promptly visited Bob Jones's ranch and was staggered to find thousands of buffalo bones exposed. With support from the National Geographic Society, I undertook excavations that would eventually yield a remarkable record of North American prehistory.

In June 1973, when our crew arrived, a surprise awaited: Bob had set up a camp for us—two trailers, electricity, and a pump-equipped well.

Radiocarbon dating of this and other Hell Gap sites indicated that the slaughter took



ALPHEA WITTEK (LEFT) AND KERRY J.

An intriguing puzzle of 41,000 pieces, when solved, revealed an orderly distribution of bones suggesting that the band of Stone Age hunters was well organized and perhaps had operated as a butchering assembly line. Flint weapons came from widely scattered deposits, indicating that diverse groups may have banded together to hunt big game.



place about 10,000 years ago. But how were all the animals killed? I conjured visions of them being driven over cliffs or cornered in canyons. But no such terrain existed here. Why were these bones found, in fact, on a ridge rather than in a draw? Had the landscape changed drastically in the past ten millennia?

River Probably Flowed Near Site

Geologist John Albanese told me that in those times "the Arikaree probably flowed much closer to the site than it does now." Most important was John's discovery that the bone bed lay in what had been a shallow tributary draw, now filled with sediment and transformed into a ridge by the lowering of the valley floor.

We had expected to find Ice Age bison with long, straight horns, but perplexingly the horns we found were shorter and more curved. Examining the skulls and jawbones, we saw that they came from females and young animals. Our cache represented the remains of a nursery herd, which, among modern bison, forms when the bulls go off on their own in the fall.

Charles Reher, a University of Wyoming bison authority, verified that the kill had occurred in winter by examining the tooth

wear and tooth eruption of the young animals. But he also discovered that they had not all been killed at the same time. Some were butchered in early winter, others probably during midwinter, and others even toward spring.

We found more than three hundred stone and bone artifacts scattered among the bones, including scores of flint spearpoints. Yet we uncovered few flint knives or choppers, implements that normally would have been used for cutting up the animals.

Inspection of the spearpoints revealed that many were chipped along one side of the blade—the type of damage that would result from using the blade as a knife. One blade was found together with the flakes trimmed from its edge as it was resharpened—strong evidence that it was used to skin the animals and cut the meat.

The flints varied in color and texture. Larry Banks, an expert on flint identification, determined that the pieces came from deposits in Kansas, Nebraska, Texas, and Wyoming, as well as Colorado.

Did these ancient hunters visit those areas, or did they simply trade stone with neighboring bands? Or did groups of hunters from different regions assemble for winter hunts? Only more research will tell.



NATIONAL GEOGRAPHIC PHOTOGRAPHERS JOE BRIDGES AND LARRY D. KIRBY (LEFT); JOE BRIDGES (RIGHT)

Whiplash force adds lethal efficiency to spears thrown with an atlatl, a device often used by prehistoric hunters. Holding a grooved atlatl in his left hand (right), the author fits the spear's flint-tipped foreshaft into the six-foot-long main shaft before loading the butt into the groove. To throw, he swings it back and then forward over his head, snapping his wrist at the moment of release like a baseball pitcher, as shown in this nighttime multiple exposure (left). Accuracy and throwing power were skills that spelled life for the winter-driven hunters of the Ice Age.



The bones taught us more and more. The toss piles were largely differentiated: leg bones in one pile, ribs in another, and so forth. Butchering had been well organized. It suggested production-line methods and a complex social organization, with authority centered in a hunt leader.

Evidence Recalls Canadian Hunts

I began reading accounts of other buffalo hunts, described by early frontiersmen. Cree and Assiniboin Indians on the Canadian plains hunted in winter on foot. They built pounds, or traps, into which buffalo were driven. Often the entrance was a ramp of packed snow covered with water to make it slick. Once the animals entered, they could not climb out. In many cases the Cree and Assiniboin left a tree in the center of the trap, or erected a post. Around it they placed offerings for a successful kill. The hunt chief would don buffalo robe and headdress and climb the post. . . . More and more, the clues from our Colorado kills suggested scenes similar to these Canadian hunts.

On a muggy July day in 1975 fortune handed us crucial evidence. With his dental pick Jim Rancier, a University of New Mexico student, struck a stone object. "I've found the world's largest Hell Gap

point," he wryly exclaimed. He had found a complete projectile point, but less than an inch long. Normally they average more than three inches. Was it a child's toy?

A few days later George Washington University student Roni Freeman unearthed a bone with a hole drilled through its long axis, and another intersecting it from the side. A flute or whistle? Roni also discovered bone concentrations from a butchered dog or wolf. Why were they here?

Then came the real surprise: Clearing away the last bones, Jim noted a large round soil discoloration. A trench cut through the side of the spot revealed, unequivocally, the earth cast of a large post from the time of the bison kill. Had it been a medicine post? And were the tiny point, whistle, and butchered remains ritual offerings?

By summer's end we had recorded the remains of more than three hundred buffalo, all probably killed during a single winter, doubtless one of heavy snowfall. Apparently the hunters had conducted three slaughters, averaging a hundred animals a kill.

Had we really found proof of a medicine post and a ritual that existed 10,000 years ago? Probably we shall never know, but the evidence makes this conclusion tempting and, in my view, likely. * * *



Carving up a "mammoth" Stone Age style

WHEN A BLOOD CLOT felled a 23-year-old elephant named Ginsberg in a Boston zoo last winter, Dr. Dennis Stanford, author of the preceding article, took quick action. At his urging the Smithsonian Institution acquired the two-ton carcass. Soon it reposed in the snow at the National Zoological Park's Conservation and Research Center near Front Royal, Virginia, awaiting the spring thaw.

Why Dr. Stanford's interest in Ginsberg?

"While we were digging in the Colorado bison-bone bed," he explains, "the remains of Ice Age mammoths were accidentally unearthed at two nearby farms. Many bone fragments appeared to bear marks of butchering. One site produced an especially exciting find—a mammoth rib sharpened to a point. Could this be an ancient hunter's tool?

"If so, we had a significant discovery indeed. Geologic dating indicated an age of perhaps 15,000 to 17,000 years. This put the finds at least 3,000 years earlier than man's presence had been established on the Great Plains."

But did the bones really bear the chop marks of butchering? Enter Ginsberg. Her ample body provided an ideal "mammoth" for reenacting a way of life that vanished when mammoths died out some 11,000 years ago. As winter waned, Dr. Stanford readied his Stone Age tool kit: stone knives made by modern flint knappers and a spear to test on Ginsberg's inch-thick hide.

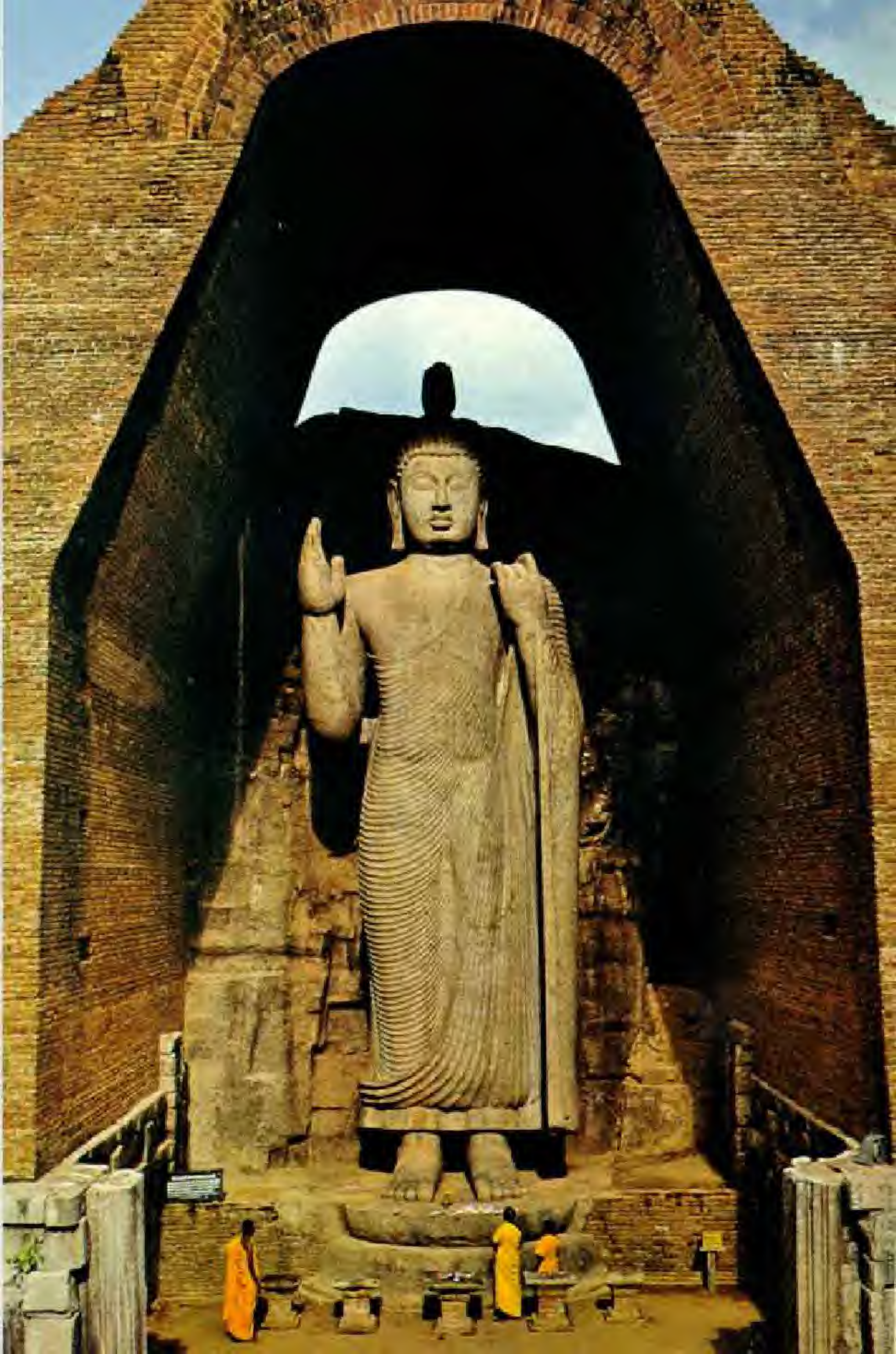
On a chill March morn the reenactment began. Wielding flint knives, scientists sawed easily through the thick hide. They exposed a mighty foreleg bone and fractured it with a rock. Chipping by a bone knapper wrought an implement almost identical to one found in the Yukon, made perhaps 30,000 years ago. A bone tip fashioned for the spear easily pierced Ginsberg, proving that even without stone, Stone Age hunters could pull down the greatest of animals.

Thus Ginsberg parted the curtains for a new glimpse of earliest man in the Americas. □



ALL BY CHIP CLARK

In an Ice Age reenactment the author saws into a dead elephant with a flint knife (top). A gauge measures the distance the knife moves. A tool made from one of the elephant's bones resembles a mammoth-bone tool struck in the Yukon perhaps 30,000 years ago (above).



THE OLD ONES of Sri Lanka, the Resplendent Land, took it for granted that paradise lay close by. Listen, they would say, you can hear the sound of the waters falling from its fountain.

In weeks of wandering this tropical island's enchanting horizons, sometimes I almost believed them. Like Marco Polo, like more and more visitors in this day, I delighted in an Eden ringed by golden beaches and crowned with misted mountains.

Pear-shaped Sri Lanka, about the size of West Virginia, rests in the Indian Ocean a handful of degrees north of the Equator. It was long known as Ceylon. Just beyond sight to the northwest, across a narrow strait, lies India, its nearest neighbor (map, page 126). On the south, at Dondra Head, you contemplate a watery emptiness that rolls away thousands of miles, to Antarctica.

Time can seem suspended in a land like this. Once I stood among silent worshipers in an ancient Buddhist temple, watching as they strewed blossoms. For more than 2,200 years the teachings of the gentle Buddha have molded these people.* My escort, a bronze-skinned philosopher in a sarong, froze the moment in words: "Life is like the flowers," he whispered. "They are born fresh. In one day they die."

But a Westerner sees, when the Resplendent Land's magical moments fade, that Sri Lankans are driven by the urgent need to improve their lot. The economy is based on three main exports—tea, rubber, and coconuts, all at times unstable. Before my visit, voters had swept out a regime described by most observers as nepotism-ridden and corrupt. With the economy in deep trouble, the new government received an overwhelming mandate to turn Sri Lanka around.

*See "Ceylon, the Resplendent Land," by Donna K. and Gilbert M. Grosvenor, *GEOGRAPHIC*, April 1966.

Towering Buddha, cut from a granite monolith, receives offerings from monks at Avukana (left). Teachings of the Indian sage shape the lives of the Sinhalese majority in the island Republic of Sri Lanka, formerly Ceylon. Doorless Buddhist reliquaries, some as high as Egypt's pyramids (right), draw pilgrims to Anuradhapura, jungle-cloaked capital of antiquity.

TIME OF TESTING FOR AN ANCIENT LAND

SRI LANKA

By ROBERT PAUL JORDAN

ASSISTANT EDITOR

Photographs by RAGHUBIR SINGH



Lush legacy of the British taste for tea, plantations prosper in the moist hill country. Venturesome Britons created the estates from peasant holdings and jungle 150 years ago, first planting coffee trees but after a blight switching to tea. They also brought in laborers, Tamil-speaking Hindus from southern India.

Since independence in 1948, Sri Lanka has counted on tea, a million pounds a day, as its top money earner. But in the past decade rising import costs have outpaced exports, and the standard of living—once the envy of Asia—has dropped. Elected leaders recently nationalized tea, rubber, and coconut plantations and limited individual holdings to 50 acres.

The status of 1.2 million Indian Tamils has been settled. India will accept more than 600,000; the rest will be granted Sri Lankan citizenship. The 1.6 million Ceylon Tamils already make up the nation's largest minority. These citizens descend from settlers and invaders who arrived centuries ago and live mainly in the north and east.







SRI LANKA

Arab mariners knew this teardrop off India as Serendip; an 18th-century English author equated it to "unexpected delights" and coined the word "serendipity." In Hindu epic it was Sri Lanka—Resplendent Land—a name the republic adopted in 1972.

AREA: 25,332 sq mi (65,610 sq km). **POPULATION:** 14,000,000. **GOVT:** Democratic Socialist Republic. **ETHNIC GROUPS:** Symbolized in the flag by the legendary lion forebear of the Sinhalese (72 percent), the saffron of the Tamils (20 percent), and the green of the Muslims (7 percent). **ECONOMY:** Agriculture predominates. **MAJOR CITIES:** Colombo, capital (607,000); Jaffna (117,000); Kandy (101,000).



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 NATIONAL GEOGRAPHIC ART DIVISION

The political problem is compounded by the animosity between the majority Sinhalese, Buddhists whose origins lay in northern India, and elements among the minority Tamils, Hindus from southern India. The social problem is stark—not enough jobs, not enough food.

Unable to grow sufficient rice, the staple diet, and lacking other items such as wheat and sugar, Sri Lanka was importing as much as half the food needed for its 14 million people. Still, many did not get enough.

This became poignantly clear on my first day in Colombo, the capital, as an enthusiastic tourism official showed me about. The entire country, with its scenic glories, ancient buried cities, and low prices, is a rare touristic bargain. The capital itself, a port city with a few modern buildings looming over narrow, congested streets, is a tumultuous relic of colonial days (following pages). In a crowded bazaar, my guide waved off some shoeshine boys. His face lengthened. There were, he told me, an estimated 50,000 undernourished children in Colombo.

"In your country," he continued, "a child asks, 'Mother, what are we having for dinner?' In my country, the child may say, 'Mother, are we *having* dinner?'"

"One of these days"—he brightened—"maybe we can ask the question as you do in the United States."

Ambitious Schemes to Prime the Pump

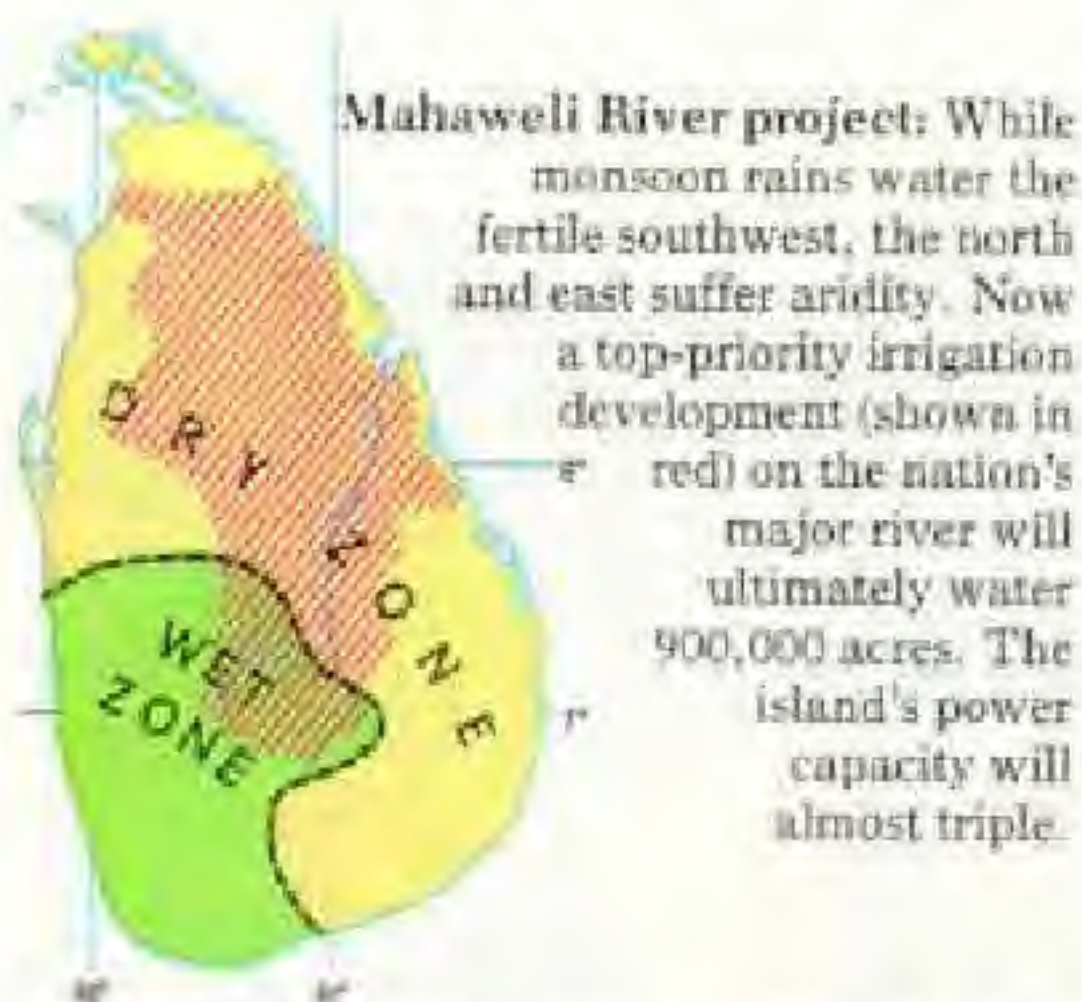
Parliament was in session nearby. In only a few months, the new government of Prime Minister Junius Richard Jayewardene had instituted major reforms. Import controls had been lifted. The nation's monetary unit, the rupee, had been freed of supports to seek its own level. And millions of people—those with incomes over 300 rupees monthly (\$19.35)—had been removed from a weekly ration of subsidized rice. Still, about half the population remained on the ration.

At Parliament, in a room reverberating with MP's taking a tea break, I talked with Prime Minister Jayewardene, who in a constitutional reorganization has since become the nation's first president to have full executive powers. He offered me tea and cakes, and we raised our voices to cope with the din. English—a legacy of British rule—is widely spoken in Sri Lanka.

A slim, vigorous man in his early 70's, long a political leader, Mr. Jayewardene briskly outlined his plans to deal with unemployment.

"We are beginning high-development programs," he said. "We will reconstruct Colombo, for one. But we will go beyond, creating a greater Colombo, with new suburbs, lakes, parks, a ring road. We also are establishing free-trade zones to attract foreign investment."

He nodded confidently. "Our biggest project is the Mahaweli scheme—dams and irrigation. It was supposed to take thirty



years. We've speeded it up. In only five years or so we'll build at least five dams on our largest river—and more later. Eventually a million new jobs will be provided. Great acreages will be opened to farming."

This ancient island has known many names. The Portuguese, who arrived in 1505, brought Western influence and the name Ceilão. In 1658 the Dutch raised their flag over what they called Ceilon. Under the British, starting in 1796, it was Ceylon. An independent nation in the British Commonwealth since 1948, it proclaimed itself the Republic of Sri Lanka in 1972.

Long before the day of colonial powers, the ancient Greeks and Romans had their own lovely nomenclature—Taprobane. To the Chinese, Sri Lanka was known as the Island of Gems. King Solomon had dispatched emissaries, so I had read, to fabled Ratnapura—City of Gems—for precious stones to woo the Queen of Sheba. I drove into the city one morning to be greeted by a

"Visitors Welcome" sign of the Ratnapura Lions Club. Solomon's agents might puzzle over that, I thought, but not over the people involved with gems. Their work has changed little since Biblical times.

Today's miners still dig pits and scoop gem gravel by hand (page 135). Many cutters and polishers use primitive tools and methods. Dealers like Bhadra Marapana, a leading Ratnapura gemologist and art designer, make available the splendid result. I doubt that the Queen of Sheba ever acquired a sapphire as fascinating as the stone the ebullient Mr. Marapana unveiled for me.

When I stopped by, he was wearing a heavy gold necklace of his own design, its pendant a woven gold basket of rubies,

sapphires, and a glowing cat's-eye. Man and bauble bounded to and from the office safe as he set out a treasure trove on his desk.

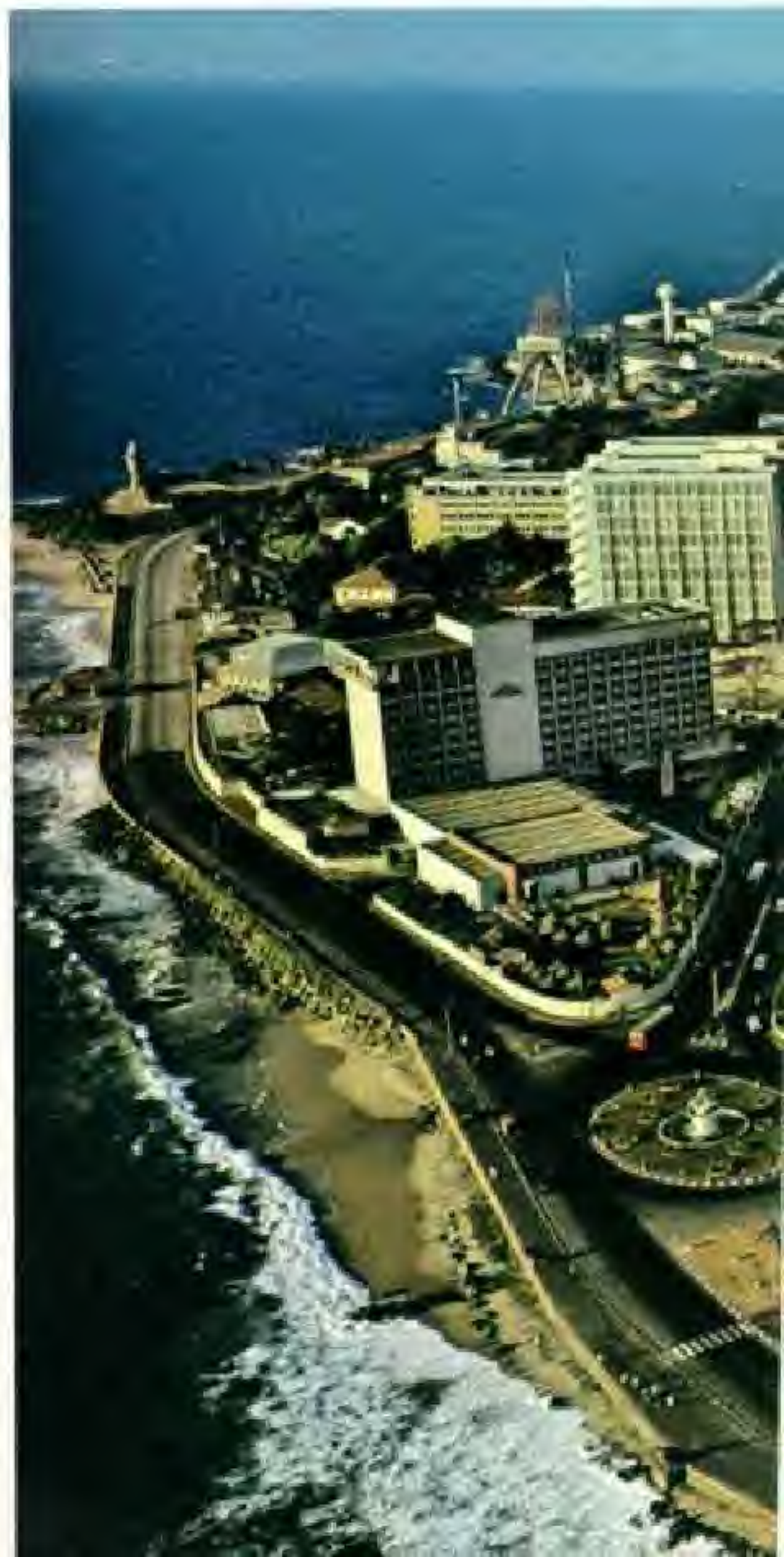
"Seventeen carats," the gemologist said, fingering a blue sapphire bigger than a wren's egg. "It's worth \$35,000"—a slight shrug. "Chicken feed in the gem world." Mr. Marapana casually nudged it alongside other sapphires—not only blue ones, but also pink, orange, yellow, white.

"Now look!" he commanded, excitement lifting his voice. "You are one of the few to see a sapphire of *this* color. We have discovered a small number just recently. Most are flawed." With a flourish he opened a box.

On a nest of cotton reposed a large, softly glowing stone, as if a petrified globule of



Expectations rise, opportunities lag for students at Sri Lanka's universities. Half the population is under 20, and many youths seek higher education, which is free. But a degree is no job guarantee, even in Colombo (right), now attempting an economic comeback. Its fine harbor seeks to regain lost prominence as a major port.



purest honey had come to rest there. A star, or asterism, graced it. "It's not yellow," he declared. "Not golden. Not brown. It's honey-colored. And it's perfect. It has no price. I don't feel like selling it."

Dealer in Jewels Seeks a Greater Gem

In Sri Lanka the gem trade follows a straightforward procedure. The miner sells to a dealer in rough stones, who sells to the cutter-polisher, who sells to the wholesaler-retailer. The latter, like Mr. Marapana, also designs settings and may find markets for his jewels in many parts of the world.

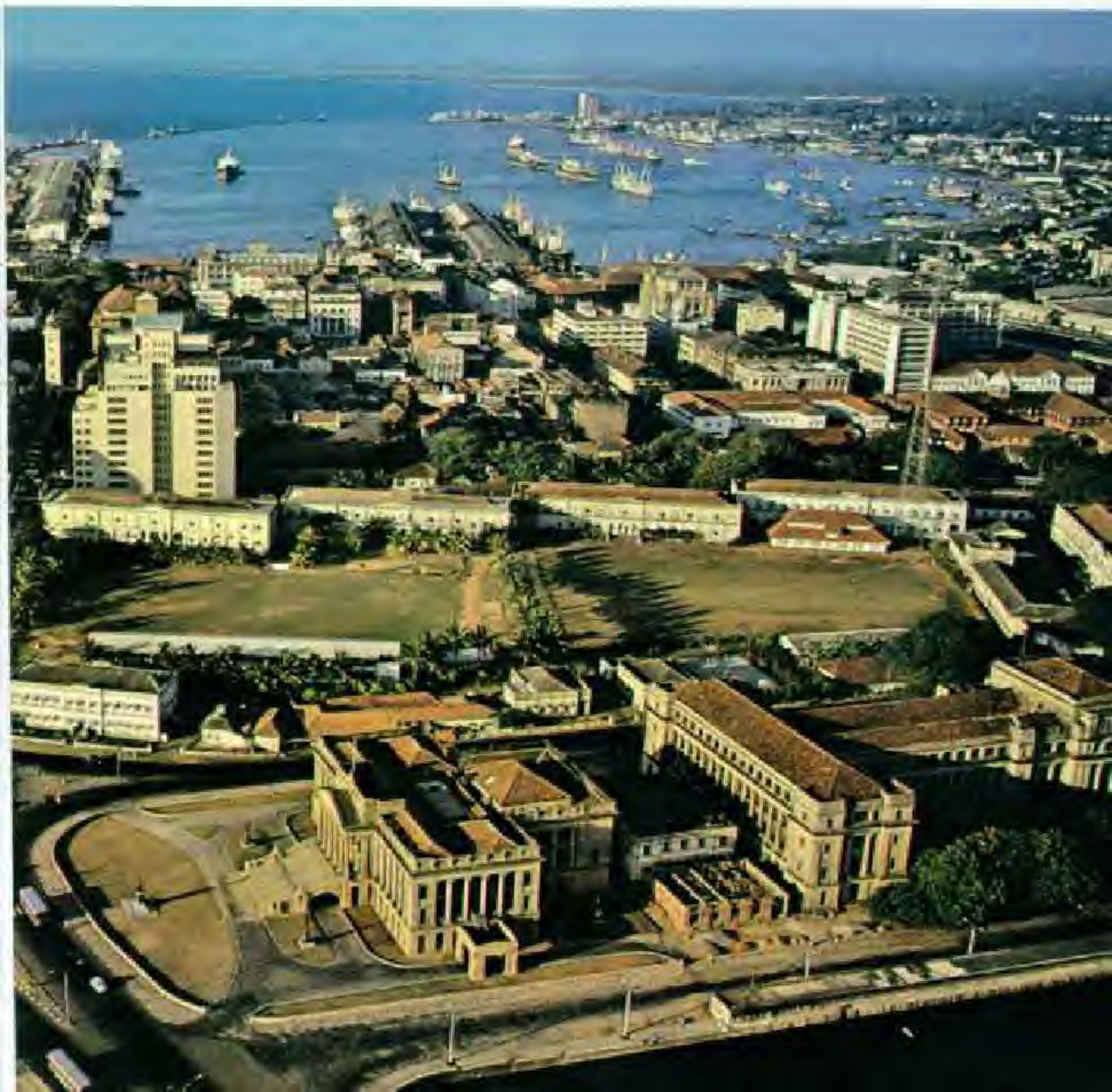
In the instance of the honey-colored sapphire, however, my host had gone a step beyond. He had become the collector, a role at

which he excelled. He had begun collecting gems two decades earlier. Now 43, he valued the result in the millions.

"I don't do mining," Mr. Marapana told me, "because it's too much of a gamble. I don't even like to sell. My wife and son do the selling. As a designer, I am an artist."

Then the artist turned philosopher. "What is money? Many people have money, but they are unhappy. They always want more. The most precious jewel you can have is wisdom."

I left on that note and headed for the muddy gem pits that puncture the paddies beyond Ratnapura. The first miner I met may have been a bit short on wisdom, being only 21. He had no money at all.





The tropics are bountiful but cannot feed a growing population. Extra food is imported—and paid for in part with loans from abroad. A porter in a Colombo market (above) totes bananas, a daily staple for many. Likewise the coconut; the fruit and its tree yield meat, milk, oil, and thatch. Husks are water-softened to smelly pulp (facing page) and woven into rope.

He and his unsalaried teammates were prospecting share and share alike. No gemstones had turned up as yet in this new pit, a timbered hole about fifteen feet square and forty-five feet deep with several stygian tunnels angling from it.

Life was Kulasinghe Buddararichchi's most precious jewel, and he showed it off with style. Lithe and muscular, he came up out of the pit wearing a loincloth and a jaunty grin. With one hand he popped a chew of betel into his mouth; with the other he picked a leech from his leg.

He had been a miner five years, he said. In a land of so many holidays that most people work little more than half the year, he toiled seven days a week. From 7 a.m. to late afternoon he bent his back in slimy tunnels, shoveling gem gravel into wicker baskets and cranking them to the surface. There other men would sift the gravel for gemstones by rolling the baskets in a pond.

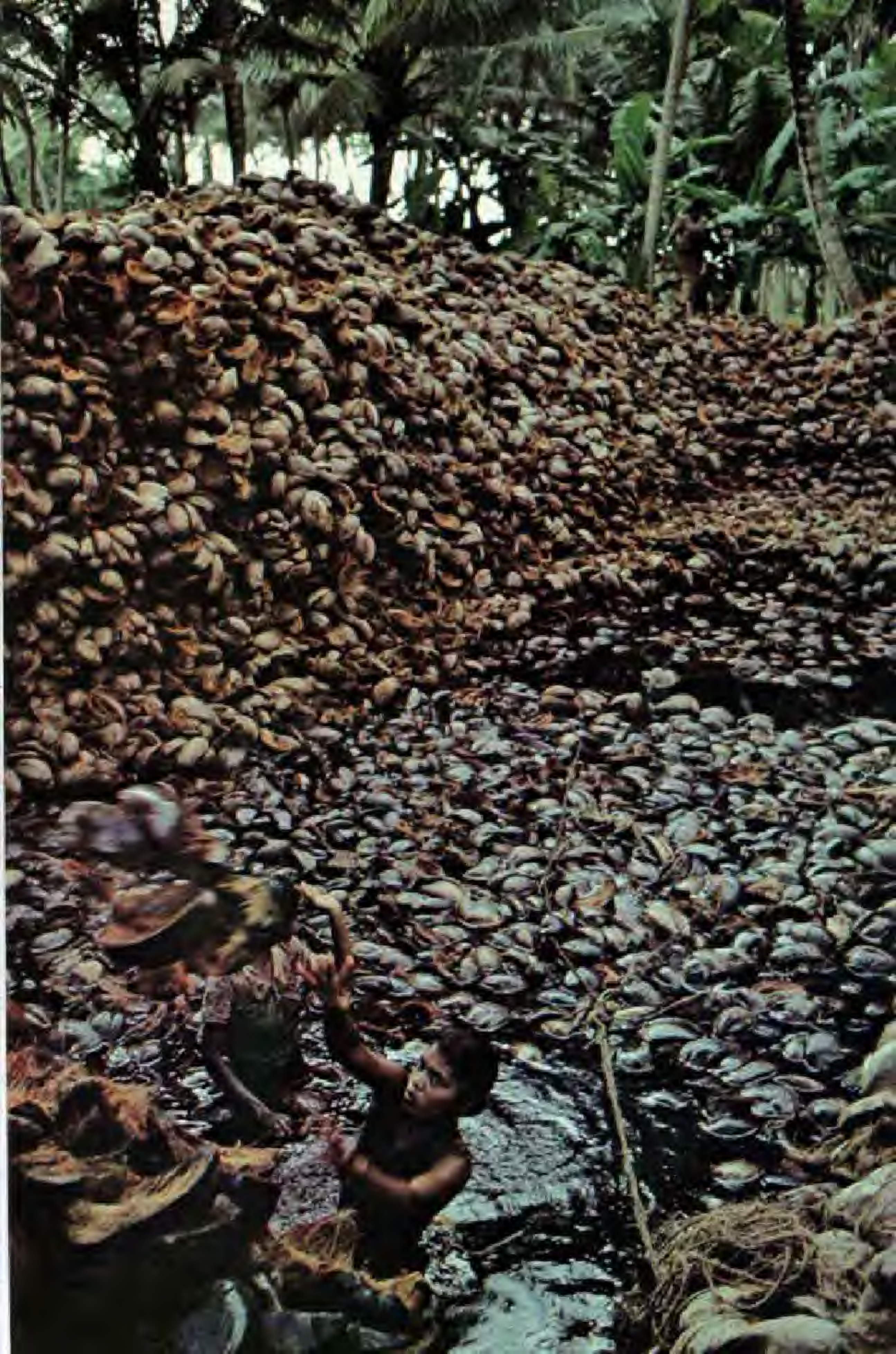
"I don't get tired," he said in unselfconscious pride. "I'm used to it. In a week you may find something. Or, four . . . five . . . six months go by and you still have nothing." He flashed teeth stained red by his betel chew. There would always be pits to dig and precious stones to seek.

India a Migratory Springboard

The young miner was a Sinhalese, as are seven out of ten Sri Lankans. Easygoing and friendly, quick to smile, the ten million Sinhalese claim descent from Aryan invaders from north India who arrived in the sixth or fifth century before Christ. They are mostly Buddhists, and theirs is the official language of the republic.

The nearly three million Tamils, who comprise the largest minority group with some 20 percent of the population, cling to their own tongue. More than half are Ceylon Tamils, whose Dravidian forebears came many centuries ago from the south of India. The remainder are Indian Tamils, people who since the 1830's have migrated from southern India to labor on coffee, tea, and rubber plantations. Many are not citizens, and thousands are being repatriated.

The hardworking and dour Tamils have been called the Scots of Sri Lanka; most practice Hinduism. The Ceylon Tamils live mainly in the north and east. Long-standing



animosity exists between them and the Sinhalese, exacerbated by language problems.

In 1977 violence erupted anew. Mobs looted Tamil shops and homes and threw firebombs. More than a hundred people were killed. Thousands fled north, to the predominantly Tamil district of Jaffna.

A Fractious Road Toward Peace

In Parliament 17 of 20 Tamil members cried for secession. I called one morning on their leader, Appapillai Amirthalingham, a lawyer and an MP more than twenty years.

He was polite, and blunt. He said, "Tamils are discriminated against in jobs and education and by the constitution, which deprives us of fundamental rights. The Sinhalese have colonized us. We want our own autonomous state. If we fail to work out a peaceful solution here, our youth may resort to other methods."

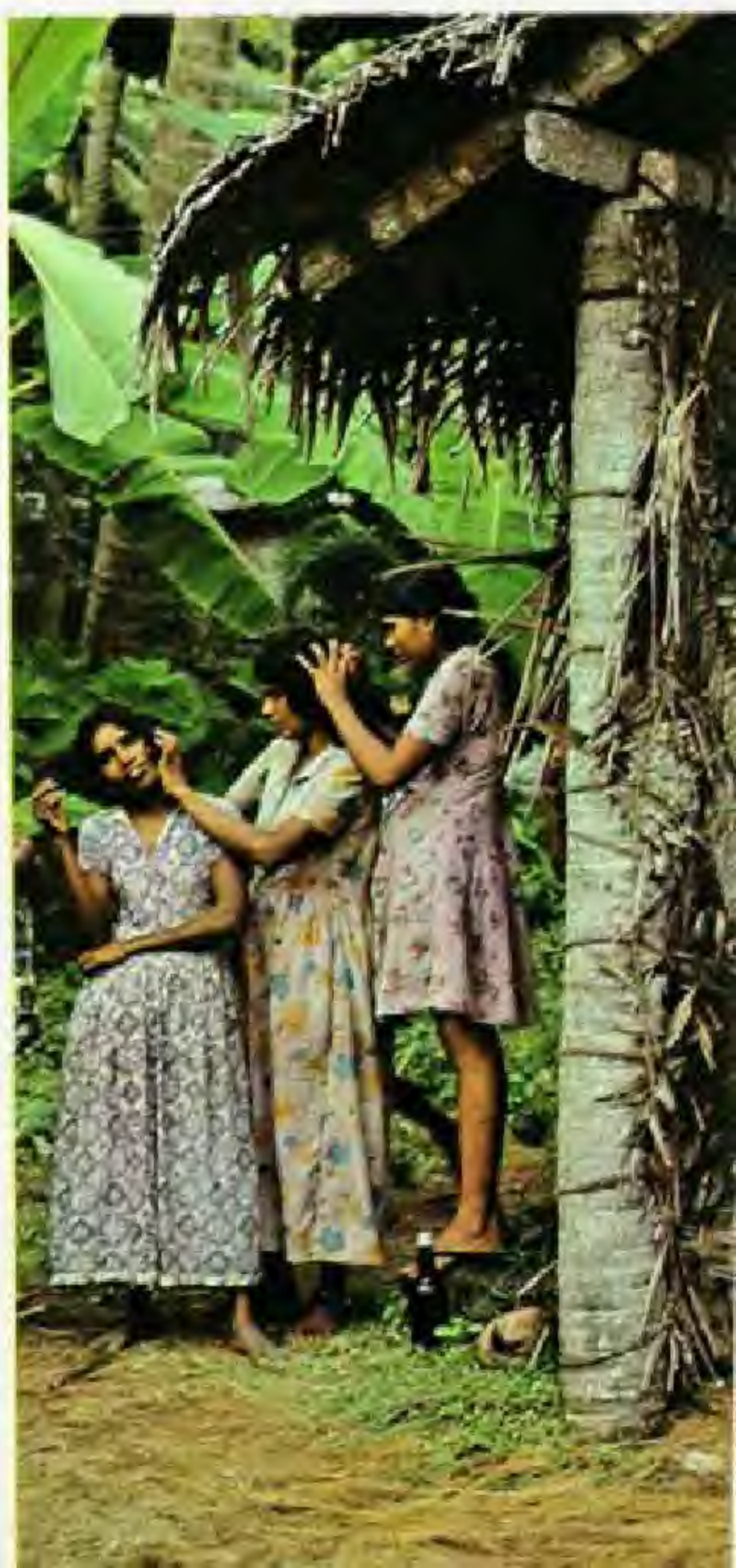
A new constitution recently promulgated may help bring that peaceful solution. While Sinhala will remain the country's official language, both it and Tamil will become national languages. In areas where Tamils predominate, their tongue—already used in the courts—also will be the language of public administration.

Sri Lanka's other minorities include the Burghers, Christian descendants of European colonists; a million or so Muslims; and Eurasians, Malays, and a scattering of Veddas, the island's earliest known inhabitants.

In this multiracial society of rising expectations, I found startling incongruities. Thirty years of universal education have produced a literacy rate of 86 percent, among the best in Asia. Still, a fifth of the

work force lack jobs. And life expectancy is 68 years, one of the highest of the world's developing nations, in a country where malnutrition is prevalent.

Though the glamorous discoveries of Sri Lanka's gem miners have brought lasting fame, farmers are the country's backbone. The economy has always been heavily agricultural. Winter never comes here, only monsoon rains. Where they get enough moisture, rice fields grow one crop after another. Unfortunately, rains are unreliable. For more than two thousand years, many farmers have fallen back on irrigation.



Trio of mutual cooperation search each other's long hair for nits, a sanitary precaution turned into a congenial pastime. Coconut fiber rides the bullock cart, traditional vehicle of the countryside. To aid poor rural areas—staging ground of a bloody insurrection by dissatisfied Sinhalese youth in 1971—the government has set up job banks, redistributed land, and speeded resettlement from the crowded southwest to sparsely populated regions to the north. There the Mahaweli irrigation project is helping to boost the biannual rice crop; last year's harvest set a record.

Though tea and rubber are economic mainstays, the coconut palm is vital to the daily existence of many rural Sri Lankans, who make up 78 percent of the population.

For Posts, Roasts, and Toddy Toasts

My driver, a balding Burgher named Nowell Bastians, proud of Sri Lanka's resourcefulness, led me into several wayside huts to demonstrate this. The man of the house would point to the rafters and thatched roof, made from the coconut palm's trunk and leaves. His wife would hold up a ladle; it and other utensils were

fashioned from the shell of the coconut. Brushes and rope came from the husk's fiber, medicine from the roots.

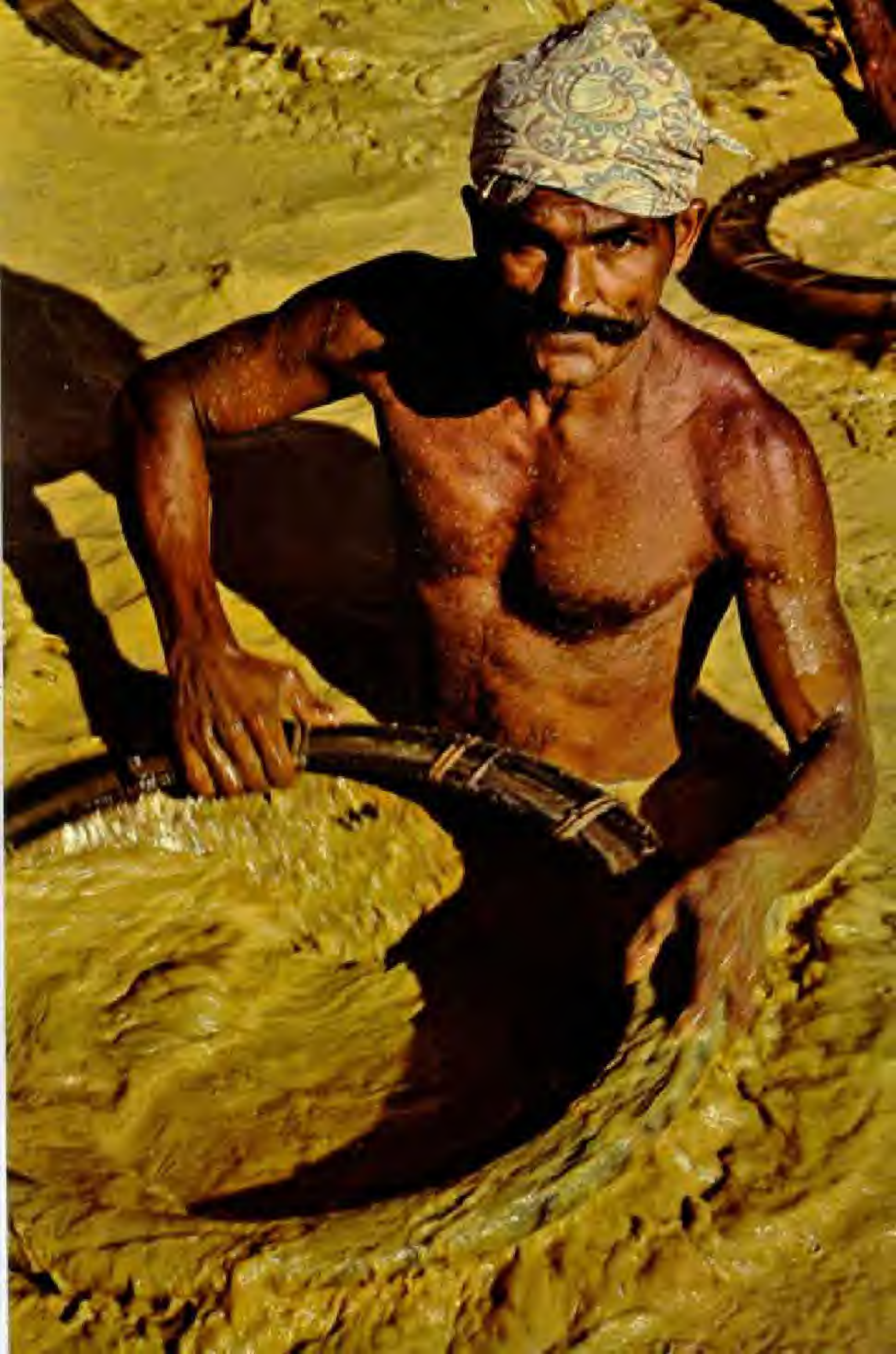
"They eat the inside of the fruit," said Nowell in his excellent English. "They cook with the oil, burn the oil in lamps, make fires with the wood. From the sap of the unopened flower cluster come syrup, sugar, and toddy [an alcoholic drink]."

I don't doubt that there are other uses. I found my own. Whenever I was thirsty, we simply pulled over to a roadside store, invariably a spindly open-fronted emporium displaying bunches of coconuts and bananas





From muddy waters comes incredible beauty—"rubies . . . sapphires, topazes, amethysts, garnets." So Marco Polo observed during a visit in 1292, and so it is today. Near Ratnapura, gem-bearing gravels, excavated from pits, are panned like gold (right). Descendants of Muslim gem traders cut and polish the stones. Buyers with well-trained eyes seek out flaws (left). Big profits go to dealer-collectors such as D. H. D. Wijayagunaratne, who furnished his home (above) with imports out of reach of the ordinary citizen. Sri Lanka exploits other minerals such as high-quality graphite, used for pencil lead and in heat-resistant lubricants.



and piles of mangoes and papaws. A few slashes of a machete, and I sipped the refreshing milk of the king coconut.

"It flushes the kidneys," said Nowell, "and settles the distressed stomach." With his cultivated tastes, he himself preferred tea—straight. "The British came with a gun in one hand, a Bible in the other, and they put milk in tea," he explained. "Many of us still put milk in tea. I do not."

On the road Nowell discussed various considerations to pass the time. Trousers, for instance. "If you wear trousers and speak English," he observed, "people will say, 'Ah, you're a gentleman.' But if you wear trousers and *don't* speak English, it's *show*."

He was above all this. On the highways Nowell drove in pants; at day's end he wrapped his skinny frame in a sarong. "The world's best pajamas," he said.



In Sri Lanka many people guide their lives by their horoscopes and return to their astrologers for all important decisions. A seer pronounces on the men, the time, and the place to dig for gems. Parents consult an astrologer on when to wean the baby. For his part, Nowell confided, upon being told that his fiancée's stars weren't in conjunction, he naturally broke the engagement.

Now he had marriage in mind again, and

this time the stars were right. "She is a Tamil," he sighed happily. "My former fiancée was a Burgher. They are very expensive. Instead of saris they like dresses, even bell-bottom trousers. They wear platform shoes—villagers laugh and say they are walking on two lumps of wood."

"Could you afford her?"

"That was the problem."

Moments later, caught behind a decrepit truck spewing black fumes, Nowell sneezed the problem away. "Excuse me," he said blithely. "A girl must be thinking of me."

Into the Mountains and the Past

Himself a respectful veteran of Sri Lanka's teeming two-lane arteries, he left it to me to marvel at the rich life we moved among. Variety spiced the miles and clogged the roads: bullock carts, speeding cars and trucks, bicycles, motorcycles, people on foot, drum-beating funeral processions led by saffron-robed monks, vendors and waving children and remonstrating monkeys.

I learned to keep an eye out for the darting mongoose; in a second he would vanish into the undergrowth to do business with cobras. The occasional lizard usually departed more leisurely. Work elephants gave compelling performances, patiently hoisting thick logs into waiting lorries.

As we headed into the central highlands, the sweet air turned cool, and gray-blue mist hung in the terraced mountains above us. Tea pickers bobbed on the emerald slopes. Presently we drove up to the old country town of Nuwara Eliya, a garden in the heart of tea-garden country, and a haunting anachronism.

For considerably more than a century, Nuwara Eliya served as an outpost of empire, a home

(Continued on page 141)

On the most auspicious day, at an hour set by an astrologer, a sari-draped bride married her Western-garbed groom, now they walk to a photographer's studio in Kandy, tradition-steeped capital of the last Sinhalese kings. Most couples postpone marriage until their mid-20's, often until both hold jobs. The trend has helped Sri Lanka lower the rate of population increase dramatically—from 2.6 percent to 1.7 in the past decade.



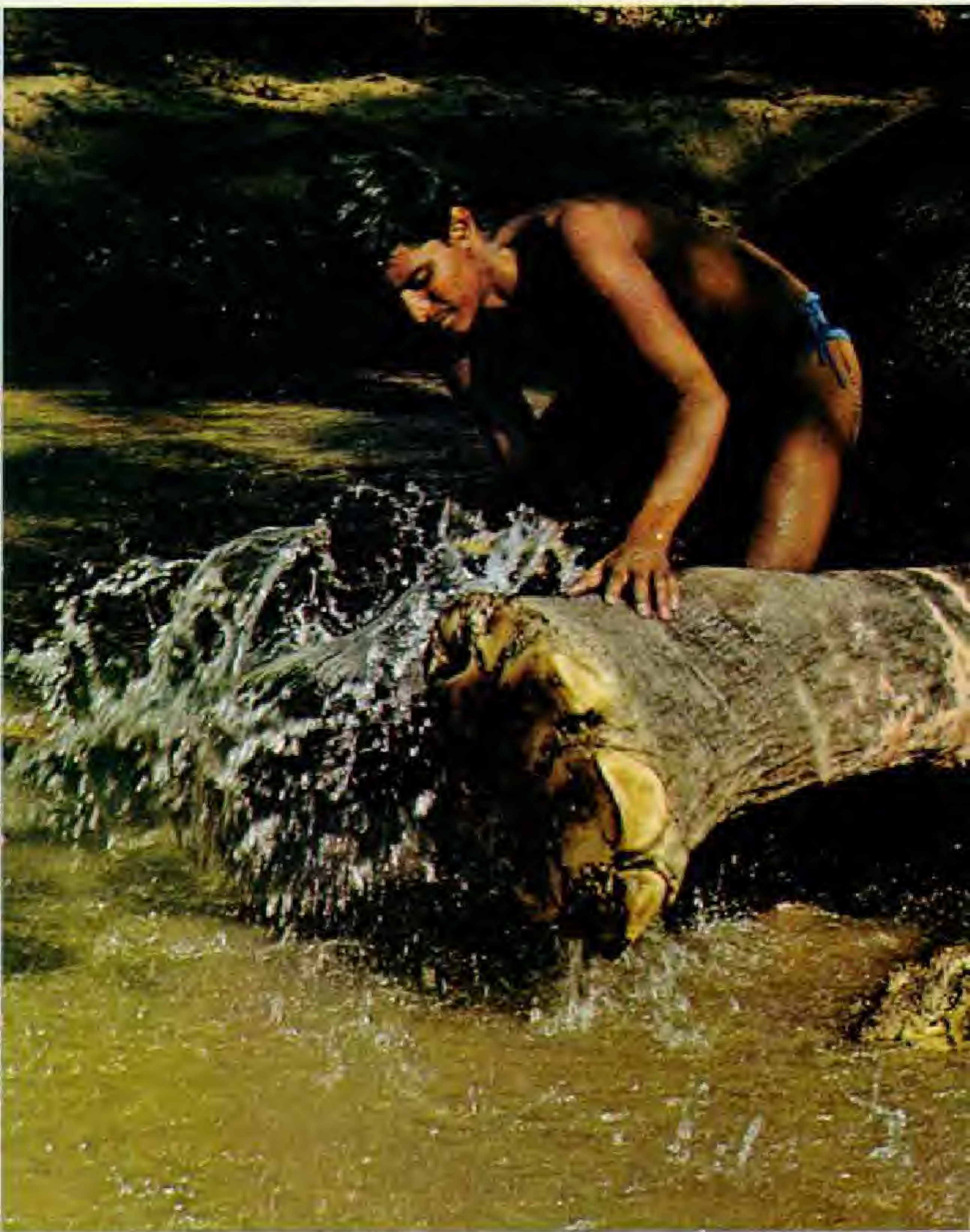


An elevated deity, a toppled leader: Religion and politics dominate the lives of Ceylon Tamils. In a show of faith—and solidarity—the community in Colombo honors the Hindu god of war and his triumph over evil during the August Festival of Vel (right).

Prospering under British rule, the Tamils feel discriminated against by the Sinhalese. When Pon Sivakumaran, a spokesman for young separatists in Jaffna, the Tamils' major city, took his life in 1974 to avoid arrest, followers raised his statue atop the rising sun of Tamil nationhood. Then in August 1977 the statue was toppled (above) during sporadic violence that erupted after a national election. Voters had ousted Mrs. Sirimavo Bandaranaike as prime minister and overwhelmingly selected moderate Junius Richard Jayewardene. The Tamil separatist party became the chief opposition in Parliament, and now Jayewardene has placed nonseparatist Tamil leaders in his cabinet. The vast majority of Sri Lankans seek peaceful solutions to ethnic problems within their 30-year-old parliamentary system.







Princely pleasures of a bath and rubdown reward an elephant after an exhausting day of road building and log moving. Some 500 working elephants, worth as much as \$9,000 each,



earn \$8 or more for a four-hour day.
More than 2,000 elephants roam wild

away from home for British planters. They built houses with gable roofs and bow windows, set out yews and evergreens and hedges, attended services in a proper Anglican church. In 1886, to make life complete, they founded a golf club. The course was still well tended and drawing players—6,250 yards, par 70 from the competition tees—when I paid my respects.

These were Sri Lankans striking the ball, however; the British planters were gone. At one time as many as 2,000 were managing tea and rubber estates. The last of them packed up and left a few years ago when the government nationalized the plantations.

Sir Winston Is Still a Presence

I drove on to the century-old Hill Club and lunched in its spacious dining room. A large fireplace dominated one end; stags' heads with luminous eyes looked down from a wall. Through floor-to-ceiling windows I gazed beyond a wide lawn to distant peaks. Immaculate in a uniform as white as the nappery, a barefoot waiter served me silently.

Later, in the men's bar, a glowering portrait arrested me. I felt compelled to read the caption beneath it: "The Right Hon. Sir Winston Churchill, K.G., O.M., C.H., M.P." Another line followed: "The Prime Minister celebrated his eightieth birthday on Tuesday, Nov. 30, 1954."

Tour groups from various countries, someone mentioned, now enjoy the club's amenities, except on special holidays. Then the members, overwhelmingly Sri Lankan, have it to themselves. I wondered what Winston Churchill would have thought.

Reluctantly I returned to the winding road. The tea plantations succeeded one another, proclaiming the old estate names. Westward Ho! Glenloch. Delta. Rothschild. Melfort. Storefield. Indian Tamil women were moving among the bushes, taking just the two newest leaves and the adjoining bud and tossing them over their shoulders into baskets on their backs (pages 124-5).

Two girls paused to chat with me, their good cheer undampened by a chill rain. One was 13, the other 15. They liked their jobs, they said. Home was an eight-room barracks shared with ten others; housing, education, and medical attention were free. Work began at 8 o'clock and ended at 4:30,

with an hour and a half for lunch. They received 9 rupees a day—about 58 cents.

To the Temple of the Tooth

In late afternoon we came to Kandy, hill capital of the last Sinhalese kings. When the British conquered it in 1815, they ended a monarchy that had ruled for more than 23 centuries. Kandyans still hold themselves special, a bit apart from other Sinhalese. Until the British, they had remained relatively unaffected by colonial influence.

Kandy—historic stronghold in a setting of incredible natural beauty. Yet it is much more than this. The Temple of the Tooth stands here. Sri Lankans make pilgrimage to this precious repository by the untold thousands. For ten days during the lunar month of Esala (July or August), they pay massed homage in a glittering age-old festival. They come to venerate the sacred tooth

relic of the Buddha, knowing they will not see it, content to be in its presence.

I too made my way to the temple, crossed over the moat, and entered to the sound of drums and wailing flutes. Humanity swirled around me. At last I found the shrine. Hidden within, sheltered by bullet-proof glass, reposed the tooth.

It lay in a golden casket beneath seven other caskets, so I was told. Guardian monks looked on impassively as worshipers offered flowers. High dignitaries may be allowed to view the relic.

Kandy is the latest and last resting-place of the tooth. Far older Sinhalese kingdoms have harbored it. Religious faith inspired by the Buddha has been at the center of Sri Lanka's very being almost from the outset.

The ruins of the island's medieval capital, Polonnaruwa, strongly bespeak Buddhism's central importance. A drive of 80



Struck with awe, pilgrims watch sunrise from the summit of a holy mountain known as Adam's Peak. Then they turn to the west to view an atmospheric phenomenon: The shadow of Adam's Peak looms on valley mists (right) and sometimes seems to bob, as if the sun itself paid homage. Four faiths hold the mountain

miles carried me there, cutting through thirsty land that the Mahaweli River development project will set abloom.

In the 12th century, Parakrama Bahu the Great built Polonnaruwa into a fortified city with royal palace, pavilions, baths, parks, pleasure gardens, and holy places. He wanted his domain to become "a festive island . . . like unto a wishing tree." Walking among his colonnaded monuments, I sensed the splendor that abided—and died.

But did it die? Surely its meaning lives on in the massive 44-foot reclining Buddha that Parakrama also caused to be carved. I lingered before the statue, almost mesmerized. It seemed palpable in its promise of nirvana, the state of a perfect and tranquil mind.

The king's engineering feats survive as well. With his capital sited in an arid region, he dug huge tanks (from the Portuguese *tanque*—reservoir) to store water, and canals

for irrigation. The Mahaweli project will tie into the old tanks and canals.

A Vaster City Than Chicago

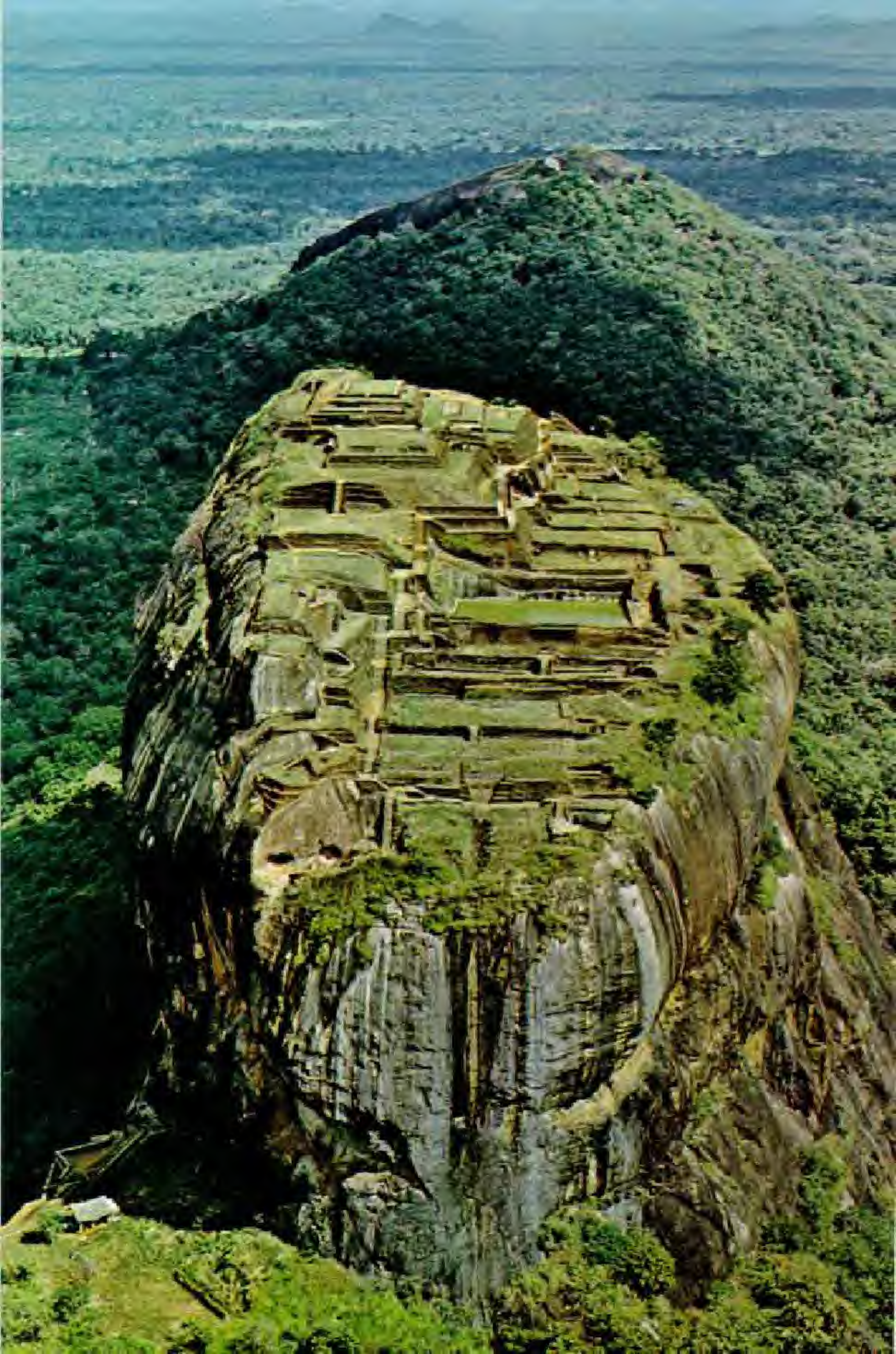
In Sri Lanka, antiquity is always relative. A much older water system is still in use in the lowlands northwest of Polonnaruwa. It serves the people who live around the most ancient, greatest buried city of all: Anuradhapura, the island's first capital.

Approaching, I could make out colossal shrines—dagobas—from miles away. Impenetrable bell-shaped edifices housing relics of the Buddha, they loomed as high as forty stories above the plain (page 123). Soon I saw ancient, lakelike reservoirs. They too will be linked to the Mahaweli project.

Anuradhapura lived from about the 5th century B.C. to the 11th century A.D. At the peak of its glory it had an area greater than modern-day Chicago. The inner city



sacred, and the climb—a midnight-to-dawn pilgrimage on lighted stairs—binds all in one communion. Buddhists believe a footprint-shaped depression on the summit was left by the Buddha; Hindus say it was Siva. Muslims insist Adam paused after his expulsion from Eden; Portuguese Christians called it the mark of St. Thomas.





"The girl with the golden skin enticed the mind and eyes." This tribute and hundreds of others are scratched in rock near life-size frescoes (above) along the approach to King Kasyapa's 1,500-year-old palace at Sigiriya (left). Of 500 beckoning maidens who once graced the gallery's polished walls, only 21 remain, masterpieces of Sinhalese art.



Even the littlest sinner gets a hearing in St. Anne's Church at Wattala. Many Sri Lankans along the west coast converted to Catholicism almost 400 years ago, at the behest of the Portuguese who came to trade in cinnamon. The area is still called Little Rome. The church at Negombo, beside a mangrove-fringed lagoon (facing page), offers Mass in Sinhala, Tamil, and English; some worshipers arrive by boat.

contained only holy structures and the palaces and pleasure domes of royalty. Monks by the thousands took their daily rice from huge stone troughs that still exist. The workaday world hummed beyond, artisans toiling in their assigned quarters of the city.

Meditating on the Fate of Trees

Anuradhapura wrote its history for me not only in the cold stone of crumbled monuments, not only in the placid waters of its man-made tanks. One evening I joined a throng of worshipers to meditate before the sacred bo tree. Buddhists believe that it has grown from a branch of the bo tree beneath which, in northern India, the Buddha attained enlightenment. This being so, the tree I contemplated, set here in the third century B.C., is the oldest tree in existence whose origin has been documented.

As I left, a sadness struck me. Sri Lankan trees in uncounted numbers now were doomed in the name of progress. Jungles would be scraped bare by bulldozers preparing the hundreds of thousands of acres to be irrigated by the Mahaweli project.

Conservationists expressed deep concern to me. In recent decades, noted Thilo W. Hoffmann, president of the Wildlife and Nature Protection Society, farmers steadily have encroached on jungle land.

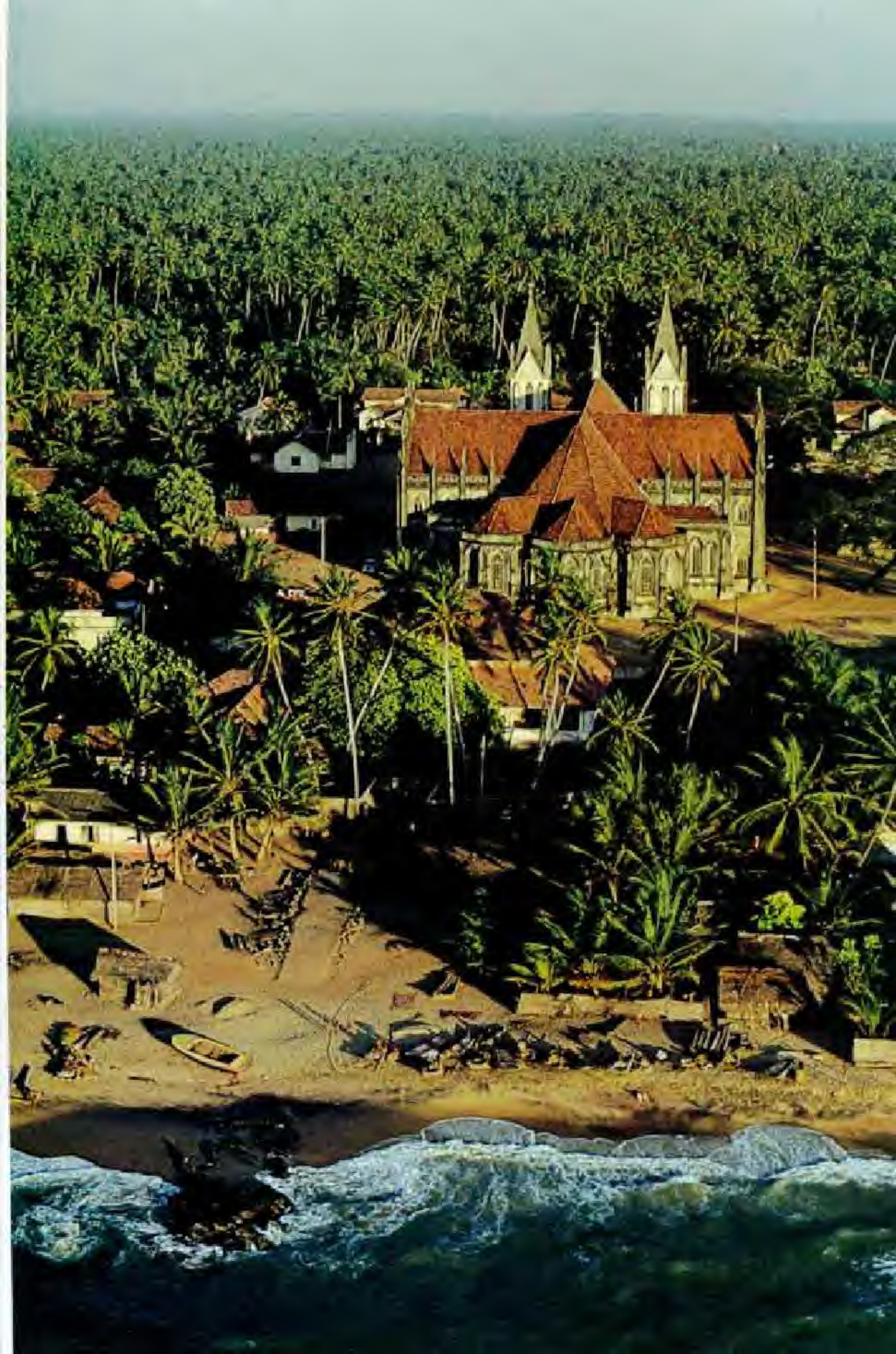
"When I came here from Switzerland in 1946," he said, "half the island cover was jungle. Today it is about 20 percent. It will vanish faster with the Mahaweli project."

Mr. Hoffmann frowned. "What's going to happen to the elephants? I'll tell you. Eradication, except for those in the national parks. As their cover disappears, *all* the animals will disappear: the leopard, the wild pig, the bear, the python, the crocodile.

"All could be safeguarded if areas of forest are left undisturbed. Conservation is as important as development, both for wildlife and the land itself. But there is no effective land-use policy in this country."

I asked an official of the Ministry of Irrigation, Power, and Highways to comment. He knew of no adverse effects so far, he said. If Sri Lanka is to become self-sufficient, he added, it must have more farmland.

Still, I thought, a construction project of this size must inescapably cause major ecological damage. (Continued on page 150)



*"THIS ALONE IS REAL; the rest
is but a dream from which I shall
presently awake," writes Arthur C.
Clarke of Sri Lanka's allure, as
here on the splendid Negombo coast
with its graceful outrigger fishing
fleet. Drawn by the beauty – and
some tax breaks – the English writer
and others have come to stay.*

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I sought out the jungle. Cynthia and Vere de Mel of Colombo—travel consultants, owners of a rental car agency, conservationists, and longtime friends of wandering NATIONAL GEOGRAPHIC writers—guided me far into Wilpattu National Park. Perhaps it was Vere's last trip into a wilderness he loved. He died not long after my visit.

For many miles Vere drove us over a rutted and muddy path in his tough old Mitsubishi jeep. As required for safety, a park tracker accompanied us. He was slight, like most Sri Lankans, and unarmed except for a small ax. "He needs no weapon," Vere said. "He is well trained." I was not reassured.

Awed Passage Through a Wild Domain

Wilpattu, which means "district of the lakes," is one of three national parks in Sri Lanka. For hours we lurched and weaved through its vastness, privileged and respectful interlopers. Sometimes jungle reached out for us on both sides, only to yield to a wide savanna. Peacocks preened in the glens, and deer browsed among the trees. Water buffalo lolled in the lakes, heedless of fishing eagles working the water.

We came to a park bungalow at twilight and sat on the veranda after dinner. The talk was of many things: how none of us wanted television in Sri Lanka, though soon it would arrive; whether the new government could stem the "brain drain" of talented youths to Middle Eastern and other lands; why people opposed a water-use tax—what the heavens provide should be free.

I fell asleep watching geckos patrol the walls for insects. At first light a crash of bird-song announced the new day. A problem arose soon after—the jeep refused to start. Ax on shoulder, the tracker set off for help. Long jungle miles lay ahead.

He returned late that night in a park vehicle with a mechanic. The walk had been uneventful, he told Vere in Sinhala. He had met a leopard, which looked at him and turned away. I had a question. "Vere," I said, "what would he have done if it had been a bear, and the bear had attacked?"

A brief colloquy. "He would fend off the bear with the ax," said Vere. "He would poke at it to make it stand erect. Then he would drive the upturned edge of the ax into the bear's groin with full force."

"*Ayubowan*," I said, putting my fingers together on my chin and nodding in Sri Lankan fashion. "May you live long."

Small Tractors and Big Hopes

For my jungle visit I only wish I could thank Vere again. For the opportunity to see the work of the Sisters of the Good Shepherd, a Roman Catholic Order, I remain in Cynthia de Mel's debt. She took me to their farming center, less than an hour's drive east of Colombo. There I witnessed in good and charming measure the underlying strength of the people I was leaving.

I saw it in the faces of young girls as the sisters taught them to be farmers—to grow crops and manage cows and pigs, poultry and silkworms. Directing work in the water-laden paddies, the sisters wore slacks instead of clerical garb. Sometimes a trifle testily they insisted on the dairy barn's cleanliness. Patiently they explained the uses and foibles of the small tractor.

Originally, I learned, the land had been a coconut and rubber plantation. When Good Shepherd took over 14 years ago, it had no electricity or running water. Now there were different difficulties: getting seed and fertilizer when needed, obtaining spare parts for equipment, finding enough money to keep going and improving.

"We advertise in the papers when it is admission time—January and June," Sister Madaline told me with a strong hint of Tipperary brogue. "Sixty girls live here. They are very poor. We take only those who are keen to make a livelihood out of farming. They stay two years."

She smiled. Would I like a glass of coconut milk? "When they leave," she went on, "we lend them whatever they need to get started—2,000 rupees, 5,000 rupees. After a year they begin paying us back."

I asked Sister Madaline if she ever returned to Ireland. "Twice in forty years," she replied. "There are nine of us here. We have plenty to do."

Another sister, a young Sri Lankan, walked with me to the door. "Our greatest satisfaction," she said, "is knowing that when the girls go from us they have a good chance in life."

I drove off hoping Sri Lanka's chances were as good. □

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SONGS OF THE
HUMPBACK
WHALE

COMMENTARY BY
ROGER PAYNE, Ph.D.
RESEARCH ZOOLOGIST
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SIDE 1
33 1/3 RPM
STEREO



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JULIE BARTLETT (BELOW) AND DES AND JEN BARTLETT



Getting the jump on kangaroos

ZOOLOGICALLY UNIQUE creatures that can leap 20 feet at a bound—and at a 35-mile-an-hour clip—made tracking by vehicle (left) imperative for Australian photographers Des and Jen Bartlett. The results of their 16-month coverage illustrate next month's issue. Along the way they adopted a 9-month-old orphan, Hop-pity, curled in pouch position in the bag held by the Bartletts' daughter, Julie (upper left). Several months later Hop-pity grew into a sometime sparring partner for Des (above). Share such far-ranging adventures; nominate a friend for membership.

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Some of the other automobile manufacturers are fond of showing their cars tearing around a test track or running an obstacle course full of pylons.

And that's fine with us. We have a test track at Honda, too. But stop and think a minute. When was the last time you had to avoid a pylon? The real world isn't pylons. It's potholes.

We designed all our Hondas with front-wheel drive. This means our cars have good traction, a characteristic that is particularly welcome when you're driving in rain or snow.

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Naturally, since we're talking about the real world, you have to remember that you're bound to hit a pothole now and then. That's why all our Hatchbacks and Sedans have four-wheel independent MacPherson strut suspension. This way the car suffers the indignities of the street, rather than the driver.

Of course, the real world is also filled with lots of nice smooth highways and perfectly-paved streets. And if a Honda is designed to handle potholes, imagine how well it must handle on all those roads where there aren't any.

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Gold!
January 7, 1979



Hong Kong:
A Family Portrait.
January 28, 1979



Last Stand in Eden.
March 4, 1979

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Janet's cranberry sauce (her secret recipe)

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Trade-marks

Sticks and shells chart seaways to distant islands

This may not look like a map. But it is. Mariners of the Marshall Islands once used it to learn their way across empty stretches of the Pacific. Strangers to paper, these seafaring Micronesians delineated their trackless domain on

latticeworks of pandanus and palm, studded with cowrie shells.

The crosspieces represent systems of consistent ocean swells driven by the winds; the shells mark reefs and atolls.

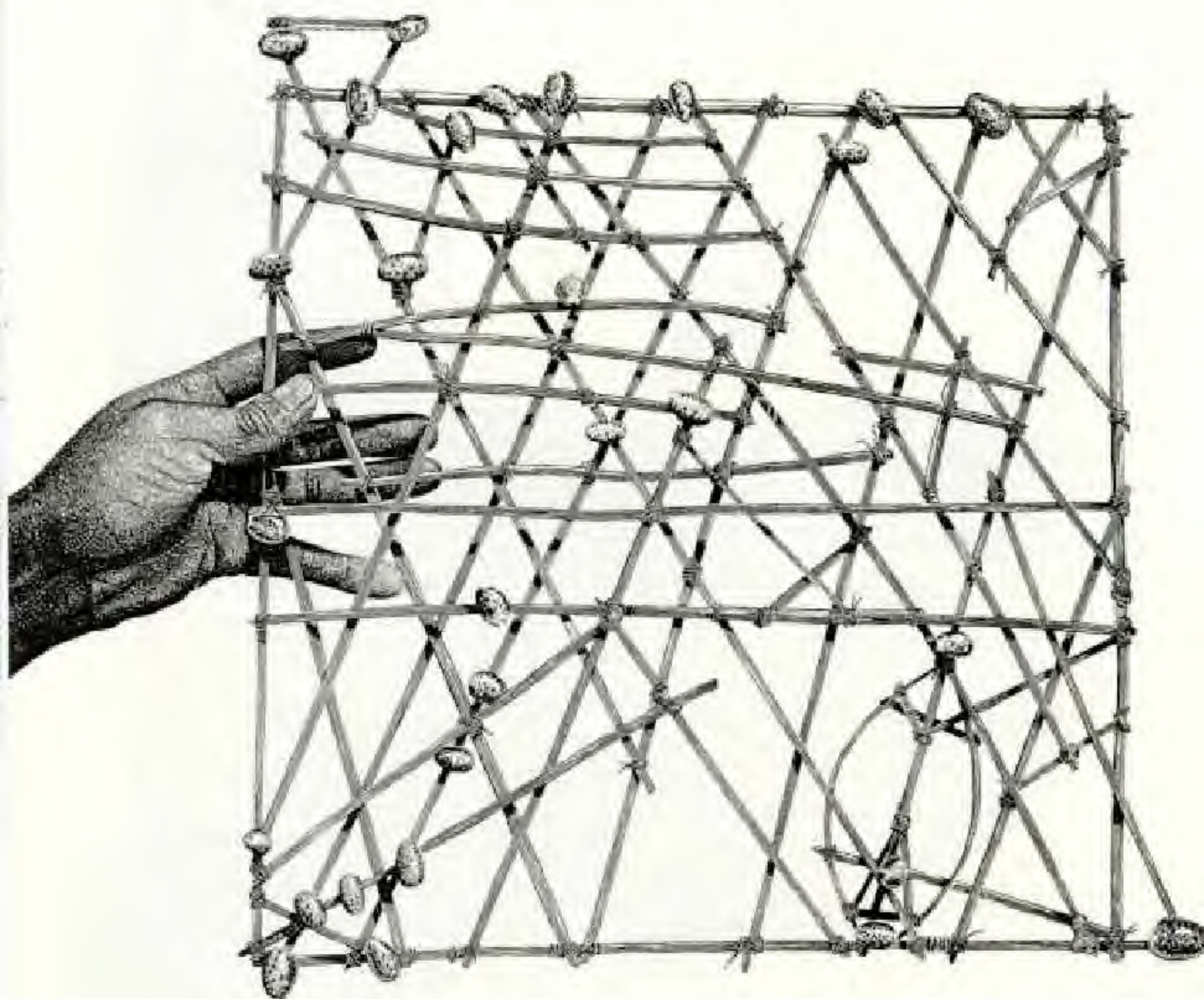
Each stick chart was the personal "shorthand" of an individual navigator, so they differ according to his knowledge and his system of notation.

Jealously guarded, the secrets woven into the charts were open only to a man in the select brotherhood of navigators. He studied and memorized the charts rather than taking them with him to sea.

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to subtle differences in their motion, the Marshallese sailor, lacking instruments, voyaged virtually "by the seat of his loincloth."

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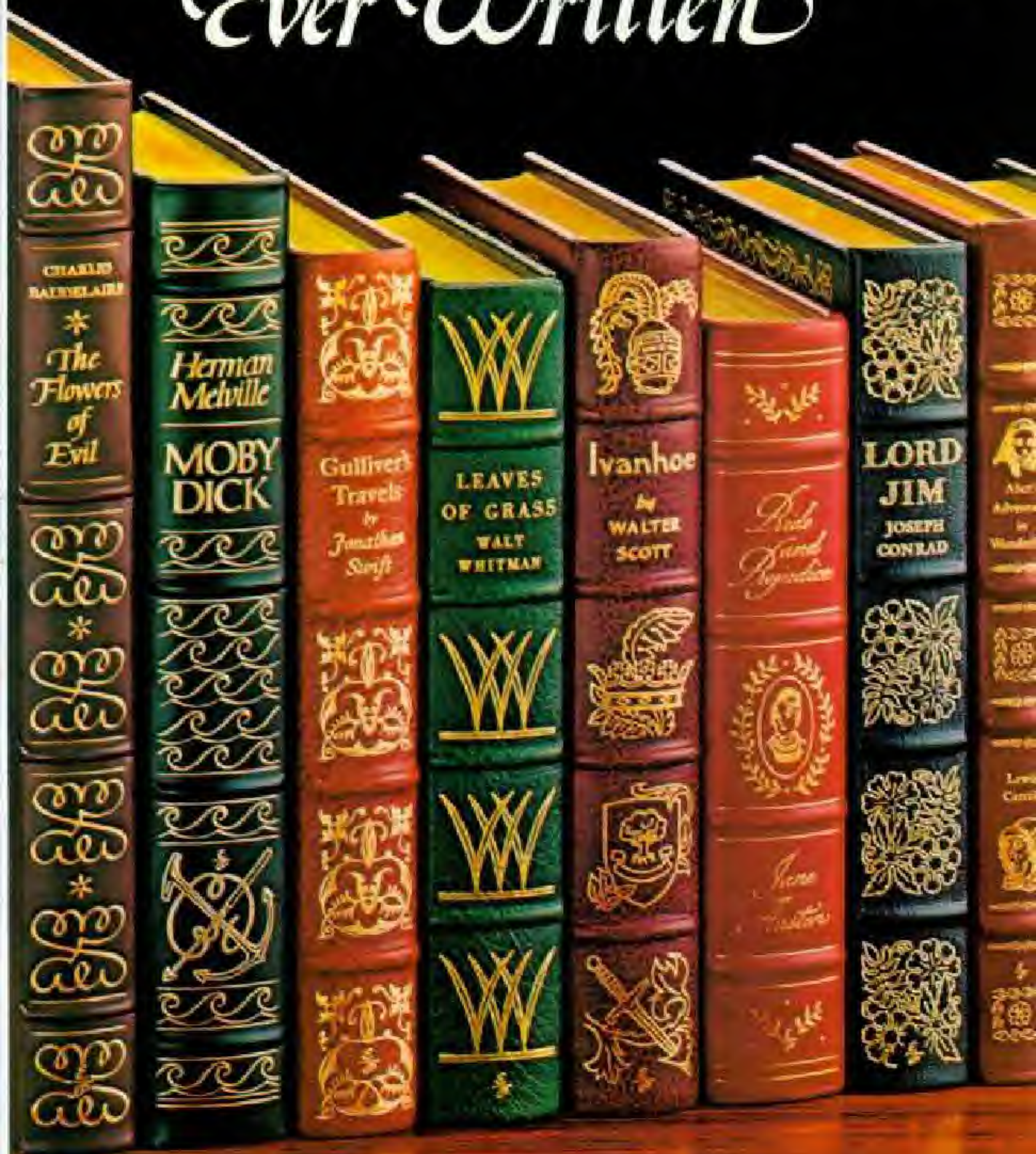


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(Continued from previous page)

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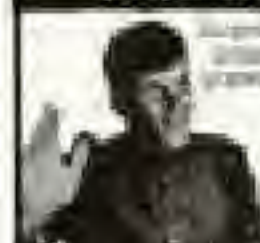
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